A

SYSTEM OF ANATOMY

FOR THE USE OF

STUDENTS OF MEDICINE.

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WITH NOTES AND ADDITIONS,

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EIGHTH EDITION.

ENTIRELY REMODELED,

AND ILLUSTRATED BY MORE THAN TWO HUNDRED ENGRAVINGS.

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IN TWO VOLUMES.

VOL. I.

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ADVERTISEMENT TO THE EIGHTH EDITION.

The publishers of "Wistar's Anatomy for the use of Students of Medicine," gratified with the favourable reception, which their attempt to enlarge and illustrate this well known work has met with, have resolved in preparing another edition for the press, to render it as far as is in their power, deserving of a continuation of the patronage it has received. For this purpose it has been carefully revised and enlarged so as to include such important additions and investigations of interest as have been recently made in the science. By comparing the present with the former editions, the reader will discover that these have been both numerous and important in each division of the subject. This the publishers have been enabled to do without much increasing the size of the volumes, by substituting, for the old copperplate prints, a very large number of engravings on wood, of the finest description. These which are intercalated with the text and explained by foot notes, cannot fail to render the work more convenient and valuable as a text book, in the various schools in which it has been adopted, and at the same time make it serve as a most useful guide to the student in the study of practical anatomy. The additional illustrations have been taken mainly from Wilson's Anatomist's Vade Mecum, (London, 1842,) and partly from the English edition of Cruvielhier's Anatomy, (London, 1842,) and from the recent splendid work on General Anatomy, by F. Gerber. The present edition of Wistar, contains eight coloured copperplate engravings of the blood-vessels, and upwards of *two hundred* and *twenty* engravings on wood, rendering it in this respect more richly and amply illustrated than any book of the kind that has yet been offered to the American student.

The same plan has been pursued as mentioned in the preface to the seventh edition, of distinguishing the new matter that has been added, from the original text of Dr. Wistar.

JOSEPH PANCOAST.

Philadelphia, 1842.

DR. HORNER'S PREFACE.

The value of the present work having been sufficiently tested by its very diffused use in the profession, and by a third edition being now called for, the editor has been induced to superintend the latter, with a hope that its utility and the public conviction in its favour have been in no wise diminished. The closeness of the connexion between himself and its lamented author, furnished, also, another and a very powerful reason, why he should endeavour by such means as he commanded, to contribute to perpetuate the memory of a man whose literary and professional career had been so conducive to the reputation of his country, and whose philanthropy and suavity of manners had established him so firmly in the affections and confidence of all who knew him.

Several amendments have been introduced by the way of corrections, alterations and additions. The latter, for the most part, appear between brackets, and in the form of notes, but there are many which could not be marked in such a manner without giving the text a garbled appearance, they therefore appear as portions of the original work.

The whole mass of matter introduced as amendments is greater, indeed, than a superficial perusal of the work would intimate; and the only way for the reader to arrive at it, will be by a careful comparison of the last with the present edition. The editor, however, has been careful not to allow the spirit of change or improvement to affect the work in any points except such as seemed to him absolutely to require it, and where he was fully warranted by the best authorities in Descriptive Anatomy. It would have been sufficiently easy for him to have extended the work considerably beyond its present dimensions; but from its having been originally designed as a text-book of the course of Lectures on Anatomy in the University of Pennsylvania, and for the benefit of practitioners, who are always most assisted by condensed views on this subject, he was apprehensive of perverting or of frustrating its objects by such extension. In consequence of which he has principally confined himself to adding where additions were called for by recent discoveries in Anatomy, and by the omission of older ones.

Philadelphia, Oct. 10th, 1823.

PREFACE TO THE SEVENTH EDITION.

The publication of the first edition of his "System of Anatomy for the use of Medical Students," was completed by Dr. Caspar Wistar in 1814. Simple in its construction, concise, but yet clear, and at the same time representing faithfully and fully, the science of Anatomy as it then existed, the book was exactly in keeping with the well known character of its distinguished author The general approval with which it was received in this country, was manifested by the rapidity of its sale.

The second edition which was called for in 1817, was further improved by the author, by the addition of such new anatomical facts as had come to his knowledge, and such further physiological observations as served to give life and interest, to the otherwise dry details of his science. In 1818, before his work had reached the third edition, the author himself died, regretted by all who loved virtue, honoured science, or knew how to estimate a kindness of soul, and uniform urbanity of manner, which is yet vivid in the recollection of his friends.

The superintendance of the third edition was assumed by Professor Horner, a personal friend of Dr. Wistar, who enriched it, by the addition of much valuable matter, which the science in its onward progress had at that time developed. The value of these additions, may be inferred, from the increasing favour which the medical public has continued to extend towards the work; four editions having been completely exhausted since that period.

Though fifteen years only have elapsed, since its former revision, the zealous and persevering inquiries of modern anatomists, which have scarcely their parallel in any other department, have in that time added much to the science. The present publishers have therefore been desirous, that the work should be so extended and remodeled, as to be brought up as near as may be, to the existing state of the science, without impairing its value as a manual by too much increasing its bulk. The reader will discover how far the attempt has been successful, by comparing this with former editions.

Within the period alluded to, the department of general, more than that of special anatomy, has yielded the richest harvest to the anatomist, and has been advantageously cultivated with particular reference to physiology and therapeutics. From general, then, more than from special anatomy, have the present additions been derived; the editor believing that in mere special

description, that which is most concise and yet so comprehensive as not to omit any thing of real importance, is the best. He has not, therefore, added a great deal to the individual description of the bones, ligaments, muscles, blood-vessels, and nerves. But in the department of General Anatomy, and especially in Splanchnology—the viscera being so important in a medical point of view—the student will find the additions to have been both numerous and extensive.

The department of Neurology, which has been the fashionable anatomical study, for years past, and upon which hangs so much that is important in physiology and medicine, has appeared to him more deficient than any other portion of the original work, as the brain and spinal marrow have been described by Dr. Wistar, only from above downwards; a method which was, however, the most approved and general in his day. The editor has therefore added two entire chapters on that subject, one on the General Anatomy of the Nervous System, and one on the special description of the Spinal Marrow and Brain from below upwards, in the order of its development and the direction of its functions, retaining, nevertheless, here as in other parts, all the original text. It has also been thought advisable, to transpose several portions of the work, when by so doing, parts belonging to the same general tissue could be placed in more natural connexion, and made to correspond with the mode in which they are usually described.

Thus, the account of the brain, the eye and the ear, has been transferred from the first volume to the second, and placed in continuity with that of the other parts of the general nervous system. To facilitate the student in the acquisition of this difficult science, all the plates of the former edition, which were sufficiently accurate to be useful, have been retained, and several other copperplate engravings of the blood-vessels added, with upwards of a hundred wood-cuts, some of which are original, but the greater part collected with considerable care and labour from the newest and most approved sources.

The amount of the new matter added to this edition is nearly equal to a fourth part of the whole. The student, will, however, be enabled to distinguish readily the original text of Dr. Wistar, from the additions which have been made either by Dr. Horner, which are all included in brackets [], or from those of the present editor, which are separated from the other parts of the work by their commencing and terminating with a dash —. Various *synonyms* introduced throughout the work, and some more trifling emendations of the text, it has not been thought necessary to designate.

JOSEPH PANCOAST.

Philadelphia, Dec. 1, 1838.

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PART I.

OSTEOLOGY.

CHAPTER I.

GENERAL ANATOMY OF THE OSSEOUS SYSTEM.

Classification and structure of bones—Chemical composition—Recent researches on the intimate structure of bone—Periosteum—Medullary membrane—Cartilages—Formation of bone—Terms used in describing bones.

—The osseous tissue in man and nearly all large animals which do not inhabit a dense medium, constitutes that scaffolding or framework, upon which is supported all the soft parts of the body. Hence the bones when seen in connexion in a perfect skeleton, present so perfect an outline of the animal to which they belonged, as to be sufficient as has been shown by Baron Cuvier, to indicate clearly the shape, size, and mode of life of the animal as well as the nature of the food upon which it lived.*

—The bones may be considered as designed for the fulfilment of two principal objects—the formation of cavities for the protection of delicate and important organs, as in the head, thorax, and pelvis—and of columns and levers for support and

* A skeleton, or a structure analogous to it in its uses, that of forming a foundation upon which the body can be built, and to which the muscles may be attached in order to move it from place to place, is found in the mammiferæ, birds, and many fishes, in the interior of the body; in the crustacea and testacea, some fish, reptiles, &c., it is wholly or in part at the exterior. In a great majority of cases it is bony in its structure; it is, however, cartilaginous in many fishes, and fibrous in nearly all coleopterous insects, of which it forms the external covering.—P.

motion, as in the spinal column and the upper and lower extremities. They perform, however, but a passive or mechanical part in the movements of the body, forming supporting organs, round which the muscles, nerves and vessels are wreathed, and at the same time serve as levers, by which the limbs are lifted. They are necessarily very numerous in the human body, and exist as separate and distinct pieces, which touch one another at their extremities, where they are generally expanded in size, and their parts so nicely adjusted to each other, as to form the basis of the structure of the joints. At these places of junction, the bones are fastened together, by strong, fibrous, inelastic, inextensible bands, called ligaments.

—The number of the bones in the human body, varies accordingly as we examine them, in infancy, middle life, or in old age. Nearly all the individual bones of the adult, are developed in separate pieces in the infant, the number of which is very great, and their consolidation into single bones, is not general and complete till about the period of puberty: many of these separate bones of the adult, especially of the head and trunk, are found fused together in extreme old age.

—Anatomists have generally agreed to consider as distinct bones, those of the adult, and to these they have given individual names. The skeleton is divided into trunk, head, and extremities:

—Thus there are *for the trunk*, fifty-three bones; the twenty-four true vertebræ, the sacrum, the coccyx, twelve ribs on each side, one sternum in three pieces, and two ossa innominata.

—*For the head*, fifty-nine bones; the occipital, sphenoid, ethmoid, frontal, the two parietal, two temporal with the four small bones of the ear, the vomer, the two superior maxillary, two palatine, two molar, two nasal, two lachrymal or unguiform, two inferior turbinated, the inferior maxillary, the teeth, and the hyoid bone.

—*For the two upper extremities*, seventy-four bones; there are on each side, the scapula, clavicle, humerus, radius, ulna, eight wrist or carpal bones, five metacarpal, fourteen phalanges, and five sesamoid bones.

—*For the two lower extremities,* sixty-six bones; on each side one femur, a tibia, a fibula, patella, seven ankle or tarsal bones, five metatarsal, fourteen phalanges of the toes, and two and sometimes three sesamoid. Thus according to the enumeration of Marjolin, there are two hundred and fifty-two bones in the human body. The number of sesamoid bones, however, is very variable; and some anatomists of high reputation, do not include the teeth in the enumeration of the bones of the body.

—The bones are all either symmetrical or unsymmetrical. The symmetrical bones are in pairs, and correspond in size and shape very nearly with each other, and are placed upon the side, like those of the extremities and ribs. The unsymmetrical, which consist of some of the bones of the head, the sternum, vertebræ, sacrum, os coccygis and os hyoides, are situated in the middle line of the body; the lateral halves of these bones correspond very closely with each other.

—From their general form and geometrical dimensions, the bones have been divided into classes; the long bones, *ossa longa*, the broad bones, *ossa lati*, and the thick bones, *ossa crassa.* The long bones, occupy the centre of the limbs, are the levers used in locomotion, and form a series of broken columns, articulated together, which increase in number, and diminish in size, as they recede from the trunk. They are divided into a middle part, body or diaphysis; and into extremities or epiphyses. The body is cylindrical in some, prismatic and triangular in others, and generally a little curved or twisted. The extremities are expanded and thick. The bodies which are the smallest part, happily correspond with the bellies or largest part of the muscles—the extremities with their narrow tendinous terminations.

—The broad bones assist in forming a part of the walls of the trunk and head; they are flattened, more or less concave on their interior, varied in their form, and thicker usually at their margins, than at their centres.

—The thick bones are assembled in masses, and form parts at once solid and movable as in the spinal column, the wrist, and the ankle.

—The human bones in a recent adult subject, are of a dull white colour: they possess considerable elasticity, but little flexibility, have the greatest specific gravity of any portion of the human body, and are liable to be broken by violent efforts. Their texture is varied not only in different parts of the skeleton, but in different parts of the same bones. Thus in the long bones, the middle portion or diaphysis is compact, or nearly solid, with a cavity in the centre; the extremities are cellular or spongy, with but a thin coating of the compact matter; and the central cavity, is occupied by a long network formed of thin plates and fibres, called the *reticulated tissue* of the bones.

—In flat bones the external surfaces are composed of firm plates of compact bone; but the internal substance is cellular. In some of these bones, the cellular tissue exists in such small quantity, that the external compact layers almost touch, and the bones become then diaphanous or translucent.

—The thick bones are formed almost entirely of the spongy or cellular substance, which is surrounded by an extremely thin shell of the compact bony matter, and are somewhat darker in colour than the long or the flat.

—The osseous tissue thus presents three modifications of form; the compact, the reticular, and the cellular or spongy. The compact, which is the densest and strongest, is placed upon the outer surface of all the bones of the body; it forms a covering of greater or less thickness to all the flat and thick bones, and adds to their strength, without much increasing their weight. The long bones, which are narrowed down in the shaft, so as to accommodate the muscles, without destroying the symmetry of the limbs, and require to be made of the strongest material, have their shafts or bodies formed almost entirely of the compact portion. The cellular or spongy is found, in a greater or less degree, in every bone of the body; in the extremities of the long bones it is continuous, though indirectly, with the reticulated tissue of the central or medullary canal. The reticulated tissue has been considered only a modification of the spongy, being formed of larger cells of a more delicate texture.

[The cellular structure of bones is attended with several important advantages. In the cylindrical bones it gives great additional strength, by increasing their diameter, without adding to their weight; for by swelling out their articular extremities, it produces much greater security of the joints, by obviating the tendency to dislocation, and rendering their movements more steady. A simple experiment will satisfy any one that the increase of volume in the extremities of the long bones, is not attended with an increase of osseous matter; for in the dried bone, the section of an inch from the centre will weigh as much as the same length from the extremities, notwithstanding the greater size of the latter. Dr. Physick has pointed out another very important advantage of the cellular structure of bones, besides those of its making them nearly as strong as if they were solid, and at the same time diminishing what otherwise would have been a weight too oppressive for the muscular powers. He thinks that thereby the concussion of the brain, and of the other viscera is frequently prevented; and in nearly all cases diminished, in falls and in blows. He illustrates the position by showing, first, the concussion which takes place through a series of ivory balls suspended by threads; if one be drawn to some distance from the others, and allowed to impel them by falling. The momentum in this case impels the ball at the farther end of the row, almost to the distance from which the first one fell. But if a ball of the same size, composed of the cellular structure of bone, be substituted for one of the ivory balls, and the experiment be repeated, the momentum of the first ball is lost almost entirely in the cellular structure of the substitute; particularly if the latter be well soaked previously in water, so as to give it a condition in point of moisture allied to the living state. Adopting this experiment as demonstrative of the fact, Dr. Physick asserts, that in falls from an eminence upon the feet, the percussion, by the time it has passed through the cellular structure of the foot, leg, thigh, vertebral column and the condyles of the occiput, is very much diminished in force, and carries much less impulse upon the brain. Again, in blows on the head, the brain, though much protected from

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external injury by the arched form of the cranium, has an additional security from the interposition of the diploe, which weakens the force of the blow.

In all the bones there are canals, independent of the cellular structure, which penetrate to a greater or less extent between the lamina, and go in various directions, some longitudinal, others oblique and transverse. These canals transmit the blood-vessels, and were first pointed out with exactitude by Clopton Havers, an English anatomist.* But he assigned a wrong application to them, as he believed that the marrow ran through them, in order to make the bones supple, and to unite their lamina more strongly. S. B. Albinus corrected the mistake, by demonstrating that they were filled with blood-vessels. These canals in a vertebra are particularly large, and open on the posterior face of its body, by one or two large foramina. In the cranium they are remarkably well seen; but their discovery is of more modern date. M. Portal says, that in the bones each kind of vessel has a particular canal for itself alone; those of the arteries are therefore to be readily distinguished from such as belong to the veins and to the nerves; and this takes place both in the large and in the small canals. Occasionally the vessels dip into a common canal, but if any one will take the trouble to follow them, he will find them ultimately separating from each other.]

—The canals for the transmission of blood-vessels, which exist in abundance in the compact bony tissue, cannot be well seen in the healthy state, except by the aid of the microscope. With the aid of this instrument they may be seen in great numbers, running in a longitudinal direction, opening in its internal or medullary cavity, so as to maintain a free communication between the vessels on the exterior, and those in the cavity of the bone.

—When cut in surgical operations, blood issues from the compact substance, which is also susceptible of inflammation and its consequences like other vascular parts. In inflammation,

* These canals are about one-twentieth of a line in diameter according to Beclard, but much less agreeably to Deutsch and Miescher.—P.

the compact portion, is sometimes seen swelled and expanded, so as to develope in its substance, a cellular arrangement, somewhat like that of the common spongy tissue. Maceration of a bone in water, after its earthy part has been removed, exhibits the same cellular structure. In fact, the principal difference between these varieties of bony tissue, consists in their difference of density, with some variation in the disposition of their fibres; the cells being condensed in the compact portion so as to admit of a decrease in the diameter of the bones, without a corresponding diminution of their strength. Hence the amount of substance being the same, in the extremities and shafts of the long bones, sections of equal length must of course be of equal weight.—

—In structure bone is composed of lamellæ, which are concentric in long and parallel in flat bones. Between the lamellæ run the vascular canals of the bones, and are lodged the bony corpuscles, which have been lately discovered. See p. 46.

—In the firmness of their texture and their general aspect, bones resemble inorganic matter, but they are nevertheless highly organised.

For example, if a bone be macerated in certain acid liquors, the earthy matter will be dissolved, and a membranous or cartilaginous substance will remain, resembling the bone in form and size.*

If the bones of a young subject, after being injected, be treated in the same way, this membranous substance will appear to be very vascular—when the injection has been successful, it will appear uniformly reddened by the greatest number of vessels which are filled with the matter of injection. These vessels discharge blood when the periosteum is removed from the surface of bones, in the living subject, and they also form granulations upon bony surfaces that have been thus denuded.

—On the other hand if a recent bone be exposed for a considerable time to the action of a moderate fire, or boiled for

* One part of muriatic acid to thirty of water is a good mixture for this purpose, by taking care to keep up the strength of the mixture by additions of the acid from time to time.—H.

a long period in a Papin's digester, the other element of the bone may be obtained—its earthy structure—in a separate state, representing the original perfectly, in size and shape. It is then perfectly white, and is so light and brittle as to crumble on the slightest touch.

—Exposure of bones for a long time to the action of the climate, will cause it to shell off in layers and fall into powder, from the same cause, the destruction of its animal matter.

—A bone macerated in acid, or well incinerated, may be torn or split in particular directions, more readily than others, and manifests an apparent fibrous arrangement.

—In regard to the disposition and arrangement of these fibres, anatomists differ, though it has been with them a subject of much research. The length of each fibre is limited, running but a small part of the length of the long bones, but is much greater than its breadth and thickness. The greater part are longitudinal, that is, run in the direction of the axis of the bone; some are transverse and some oblique. From the shortness and varied direction of the fibres, and the cellular appearance of the bone when macerated, Scarpa has denied entirely, the existence of a fibrous arrangement in the bones, and considers them composed throughout, exclusively of cellular substance, more or less compacted.

—Malpighi and Havers, believed the bones made up wholly of concentric lamellæ, formed of fibres and filaments, encrusted with osseous matter, laying over each other like the leaves of a book. Gagliardi believed also, that these lamellæ were united together by little pins of the same material: some of which were straight, some oblique, and some he fancied had round heads. De Lasone says that these lamellæ are made up of ossified fibres, united by oblique ones, and Reichel, that the lamellæ and fibres, form a porous tubulated tissue, continuous with the spongy substance.* According to J. F. Meckel, the proper

* The opinions of these different anatomists are interesting mainly as connected with the history of the science. The discrepancies existing between them, may now readily be reconciled, since the true composition or structure of bone has been rendered apparent by the use of the microscope. See page 46.—P.

substance of the bones, is of a fibro-laminated nature, the fibres in some parts being so closely aggregated, as to form a compact bone, and separated and expanded in others, so as to constitute the cells of the spongy portion. The longitudinal fibres are much the most numerous, one leaning against, and terminating near the commencement of another, so as to give an imperfect appearance of continuity throughout the bone. These fibres at the extremities of the bones, are lost in the spongy or cellular tissue which they assist to form. The transverse and oblique,* serve to connect the longitudinal fibres together, and are united with them uninterruptedly upon their sides; in the spongy portions, they appear also, to assist in the formation of the cells. They are both most abundant in early infancy, and as the bones increase in length, are directed more in the axis of the bone, till the oblique seem nearly lost in the longitudinal, and the transverse become more oblique.

—The fibres of the different layers of the compact bone, are united to one another more intimately upon the sides, than to the layers below, hence a bone exposed to the action of the weather or the fire, shells off in scales, or in certain morbid states during life, as necrosis, exfoliates in layers.†

—From these investigations the osseous tissue, may be justly considered as formed of an animal or membranous basis, analogous to the common cellular tissue and cellular fibre in other parts of the body, and differing from them only in its being imbued or incrusted with inorganic earthy matter, which gives it firmness and strength, but at the same time renders it liable to fracture. The cells of the bones, like those of the cellular tissue of the soft parts of the body, are all imperfect, having openings by which they communicate with one another, and may be all readily injected, with any fluid sufficiently thin to run; and if

* These represent the uniting pins of Gagliardi.

† Mr. Howship of England, from some recent microscopical observations on the bones, has been led to support the opinion of Scarpa, that the ultimate tissue of all the bones, is reticular or cellular. This is evidently true, in regard to the ultimate analysis of bones, when the course of the fibres has been destroyed by prolonged maceration, or by suppurative inflammation.—P.

fluid mercury be used it will make its way through the vascular foramina to the external surface.—

The existence of absorbent vessels, and even of nerves, in bones, is equally certain with that of the blood-vessels, but they are not easily demonstrated.

[The French anatomists have occasionally traced branches of the fifth pair of nerves going along with the nutritious arteries into some of the bones; but as yet no other nerves have been seen by them. M. Portal speaks in familiar terms of the existence of both nerves and lymphatics in the bones, as if he had often noticed them; he, however, has omitted to inform us of the source, from which the former come.] In the sound state bones have no sensibility, but pain is often felt in them when diseased.

—We cannot doubt the existence of the absorbent vessels in bones, since Cruikshank and Sœmmering, affirm it from their own observation, and from their own injections. Breschet, has observed it many times, and Bonamy, in making a mercurial injection of the inferior extremities, "was able to follow them for some time in the interior of the osseous tissue."

—They possess (according to Bichat,) a certain degree of extensibility and retractility, which is developed so slowly as to be almost insensible in its progress. These properties are demonstrated in the expansion of the bones of the face, from tumours of the antrum, and in the retraction of the sockets of the teeth, after the loss or removal of the latter.—

Modern chemistry has ascertained that the earthy matter of bones is principally a phosphate of lime; carbonate of lime, in a smaller quantity, is also found in them. These earthy substances compose near one-half of the weight of bones, and a large proportion of the remainder appears to be gelatinous and cartilaginous matter.

—The chemical composition of bones will be found to vary, in the different ages of life, and in some measure according to the individual bones selected for investigation; the inner compact plate or vitreous table of the cranial bones, and the petrous portion of the temporal, possessing a greater relative amount

of earthy matter than any other bones in the body. From these causes, arises considerable discrepancy in the analysis given by different chemists. In early life the relative proportion of earthy matter is at its minimum, the animal at its maximum. In advanced age, the reverse holds good, when the bones are notoriously brittle and liable to fracture. Diseased conditions of the system are known to still further modify these proportions: in childhood the earthy matter may be so much diminished that the bones become plastic and yielding, as in *rickets;* and at later periods of life, it preponderates occasionally so much over the animal as to render them liable to break at the slightest shock, as in cases of *fragilitas ossium;* and in some of the venereal affections, the bones are rendered nearly as solid and heavy as a piece of ebony.

—The earthy matter of the bones of the higher animals consists chiefly of phosphate of lime, with carbonate of lime, and a small quantity of phosphate of magnesia, and fluate of lime.

—The phosphate of lime of the bones is a subsalt, according to Müller, in which the base and acid are combined in peculiar proportions, and which is always obtained when biphosphate of lime is precipitated by an excess of ammonia. The phosphate of lime of the urine is a super-salt, held in solution; in the disease called mollities ossium, it seems to be excreted in this state in the urine in larger quantity than natural. The following is the result of Berzelius' analysis of the bones in man and the ox:

	Man.	*Ox.*
Cartilage* completely soluble in water	32.17	33.30
Vessels - - - -	1.13	
Neutral phosphate of lime - -	51.04	55.45
Carbonate of lime - - -	11.30	3.85
Fluate of lime - - -	2.00	2.90
Phosphate of magnesia - -	1.16	2.05
Soda with a small proportion of cloride of sodium - - -	1.20	2.45
	100.00	100.00

* i. e. Gelatine.

—Schreger states that in the bones of a child, the earthy matter constitutes one-half, that, in the bones of an adult it amounts to four-fifths, and in those of an old person to seven-eighths of the whole mass.

—Fourcroy and Vauquelin, found no fluate of lime in their analysis, but met with some iron, manganese, silex, alumine, and phosphate of ammonia. The luminous appearance of bones at night, when the animal matter is undergoing decomposition, is believed to be owing to the phosphorus liberated from combination; and in such instances, Bichat has found an oily or unctuous exudation at the luminous points.

—Gerdy* has very recently investigated the structure of the bones, and his observations which coincide with the microscopical researches of the German anatomists (shortly to be noticed,) appear to have set at rest many of the conflicting opinions upon the subject. He considers that there are four distinct tissues in bone, which have been confounded together up to this time; the compact, the canaliculated, reticular, and areolar or cellular.

—The compact tissue has in certain bones a fibrous appearance; its fibres appear longitudinal in long bones, radiated or irregularly divergent in many of the flat. The whole of this fibrous appearance is illusory, as Scarpa asserted, and is owing to the grooves or canals in the compact portion of the bones which lodge vessels, (canals of Havers,) run longitudinally in the compact portion, and have orifices leading into them from the outer surface; between the canals is found projecting the proper structure of the bone, which is necessarily thin, and from the great number of these vessels, presents the appearance of fibres. The vascular openings leading into the grooves, are some perpendicular, and some oblique in regard to the surface of the bones. They all conduct vessels into the compact tissue. The compact tissue, as will be better seen under the head of *formation of bone*, is primitively a compound of osseous tubes developed around the vessels. These osseous tubes which are longitudinal in the long bones and radiated in the flat, are so

* Bulletin de Clinique, 1835–6.

numerous, fine, so closely compressed together and so adherent, that their arrangement has escaped the observation of anatomists. The existence of these vessels in the forming bone is well understood, and they have been injected with mercury by Tiedemann in the parietal bone.* In the adult healthy bone, they are more difficult of detection, in consequence of the dense nature of the compact substance, in which the vascular channels of the bones and the vascular orifices on the surface are reduced nearly to a microscopical size. But when the bony tissue is diseased or inflamed, as in fractures or after amputations, their existence is no longer doubtful. Blood issues from them when cut, and the vascular orifices on the surface, as well as the canals in the compact tissue are visible to the naked eye, and in some instances are said to have been as large as a pigeon's quill. Fig. 1, is a view of these canals, as seen in a bone twenty-five days after amputation. When the orifices and canals are thus expanded, the compact tissue appears rarefied, rough on its surface, more light and fragile and corresponds in appearance with the canaliculated tissue of Gerdy.

Fig. 1†

—The absence of fibrous appearance on the thick and mixed‡ bones is dependent upon the direction of the canals, none of which run parallel to the surface, but are all directed towards the articular surfaces of the bones. In the fœtus at birth the compact portion of these bones appears sieve-like, from the number of vascular orifices on the surface, which lead perpendicularly to the canals that run towards the centre of the bones. Hence, according to Gerdy, the compact layer of these bones, is made up of minute bony rings, surrounding the numerous

* See Breschet, plates of the Venous System.—P.

† Fig. 1. Section of the extremity of the os femoris, twenty-five days after amputation. It appears cribriform from the number of irregular orifices, belonging to the canals of Havers (canaliculi,) in the compact portion of the bone. The vessels which occupy these canals, are greatly enlarged by inflammation. Cases of this sort have been confounded by writers, with inflammation of the veins of the bones.—P.

‡ The mixed bones are those which are mixed in their character; being partly short and partly flat, as, the sacrum, the temporal, maxillary bones, &c.

vascular orifices which touch each other at their circumference like the rings round the orifices of a tin colander.*

—The *canaliculated tissue,* is developed in all the bones of the body, but is least evident in the flat. It is an assemblage of small canals traversed by vessels, and has heretofore been described as a part of the cellular or spongy. In the long bones it is found on the inner surface of the compact tissue, and separated from the reticulated tissue of the medullary canal, by a parchment-like lamen, pierced with holes for the passage of anastomosing vessels. These canaliculi form elongated cavities, which are slightly tortuous, nearly parallel with one another, not exactly rounded, and have their parietes pierced with holes to admit of anastomosis, between the vessels which line them; they run in the long bones in the direction of their length, and in the thick bones, from one articular surface to the other. They arise in part

Fig. 2.†

* This we shall find is the opinion of the microscopists in regard to the structure of all compact bony layers.—

† Fig. 2. Vertical section of the inferior third of the tibia. 1. 1. Compact tissue of the body of the bone, becoming gradually thinner towards the inferior extremity. 2. 2. Reticulated tissue in the lower part of the medullary cavity occupying the axis of the cylinder of bone. 3. 3. Canaliculated tissue, the vascular canals of which detach themselves successively from the compact walls of the bone, and run nearly parallel with each other towards the extremity of the bone. 4. 4. Cellular tissue of the epiphysis, composed of interrupted canaliculi, and of tubular cells, which terminate nearly perpendicularly upon the articular surface. 6. 6. The articular or sub-cartilaginous compact tissue, extremely thin. Very generally it is

from the divisions of the nutritious foramina, which transmit the medullary vessels of the long bones, but chiefly from the vascular (Haversian,) canals of the compact tissue, as seen in a vertical section of the femur and tibia, fig. 2 and fig. 3, where the increase of the canaliculated structure is in inverse proportion to the thickness of the compact. These canals unite together, and divide again and again, so that they become increasingly numerous as they approach the spongy extremities, when they separate from each other and spread out so as to form a large part of these extremities.

—The *cellular* or *areolar tissue* of Gerdy, is formed in the thick bones and the extremities of the long bones by the interruptions of the canaliculated tissue, by other canals arising from the surface of the bone which cross them in an angular direction, so as to form quadrilateral cells, see Fig. 3, No. 1, the partitions of which are pierced, so that there is a free communication between the vessels lining the different cells.

—The reticulated tissue which was confounded by Bichat with the canaliculated, should be now as it was before his time distinguished from it. So far from being formed of a canaliculated tissue for the purpose of containing vessels, it consists only of a network of bony filaments for the purpose of supporting a delicate cellular membrane called the medullary which is thrown into the form of cells to retain the fat or marrow, and which is very vascular. It is found chiefly in the cavities of the long bones, and terminates short of the extremities in a point, see Fig. 3, 6, while the canaliculated tissue continues to expand. This tissue is beautifully developed in the long bones of the horse, but scarcely exists at all in those of the bullock.

—*Vessels of the bones.* All anatomists admit three kinds of vessels in the bones; those of the compact tissue, those of the cellular tissue, those of the medullary canal.

—Those of the compact tissue are very fine and very numerous; they penetrate it in great numbers, after having divided

deficient in places on the articular surface of bones, so as to leave the cells of the spongy tissue and their vascular canals naked when the cartilage is removed. 7. Internal malleolus.—P.

*Fig. 3.**

to capillary minuteness in the periosteum. The diameter of these little vessels, where they enter the bone, has been calculated to be about one-twentieth part of a line. The drops of blood which collect when the periosteum is stripped from the

* Fig. 3. Vertical section of the os femoris. 1. 1. Tubular cells perpendicular to the articular surface of the bone; sometimes these cells are chiefly round. 2. Cartilaginous lamin separating the epiphysis from the shaft of the bone. 3. Vertical canal opening by one or more foramina, in the fossa at the top of the trochanter, and anastomosing with the canals of the canaliculated tissue. It lodges one of the vessels of the cellular tissue; which penetrate by the extremity of the body of the long bone. 4. 4. Vascular canaliculi, which run obliquely upwards and inwards towards the lamen of the epiphysis, where the cartilage begins to be removed, and the consolidation of the epiphysis and shaft has commenced. 5. 5. Canaliculi of the upper part of the body of the bone, which are directed towards the axis of the bone, and which anastomose with the vascular canal indicated at 3. 6. Conical termination of the reticulated tissue of the medullary canal.—P.

recent bone, indicate the position of these vessels. Having entered the compact tissue, they spread in its channels (*canals of Havers, canaliculi of Gerdy,*) which are imperceptible without a microscope in a healthy bone, but become very manifest in disease.

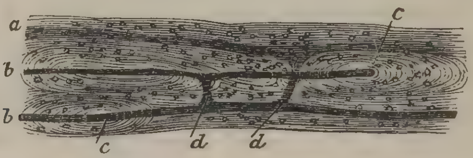
—Those of the medullary canal enter usually by a single large foramen, give off some branches to the canaliculi in their course, and having reached the medullary or central cavity, divide into two branches, which run in opposite directions towards the extremities of the bone. These branches divide and subdivide very minutely in the medullary membrane, and anastomose very freely with the vessels of the canaliculated tissue upon the side, and in the adult, (after the cartilage which separates the epiphysis from the body of the bone has been removed,) with the cellular tissue of the extremities.

—Those of the cellular tissue, that is to say the vessels of the extremities of the long bones and the large vessels of the other bones, penetrate from the surface by foramina much larger than those of the compact bone, and occasionally under the form of distinct canals. They are very numerous. I have counted 145 on the lower end of the femor, 25 upon a vertebra, and 30 on the os calcis. They anastomose intimately with the other two orders of vessels, and are particularly abundant near the articular surface of the bones, where they form the tubular cells, and as some suppose, directly or indirectly assist in the formation of the articular cartilages, which many have considered a simple product of excretion like the nails or hair. All the vessels are surrounded in the canals by a cellular tissue, more or less delicate loose and filled up with a fatty or oily matter, which is least abundant in the compact tissue where the canals are very small. No other nerves except those which accompany these vessels are believed to enter the substance of bone. These facts in regard to the structure of bone are supported both by observation and reasoning. The microscope shows us thousands of vessels in the healthy state entering into the substance of the bones. Inflammation attended with vascular congestion developes and renders them so obvious as to be appreciated by

the unassisted eye, the slightest irritation with a probe will cause them to bleed freely, and heat applied to a section of a recent bone, will develope the fatty or oily matter even in the compact portion. From the complexity of their organization, and the frequency and importance of their diseases, bones demand from the student, more earnest study, at least in regard to their general anatomy than is usually given.—

—Deutsch,* under the direction of Purkinje, and Miescher† of Berlin, whose investigations were made prior to those of Gerdy, have arrived at nearly similar conclusions in regard to the structure of bone. In very thin transverse sections of long bones, which had been macerated in dilute acid, they discovered the circular orifices of the longitudinal canals in the compact portions of the bone; and in thin longitudinal sections they were seen divided in the direction of their length. (See Figs. 4 and 5.) The canals, according to these observers, communicate here and there with each other, and constitute the longitudinal and transverse canals of Havers, and which are described by Lewenhœck, as his third and fourth kinds of pores.

Fig. 4.‡



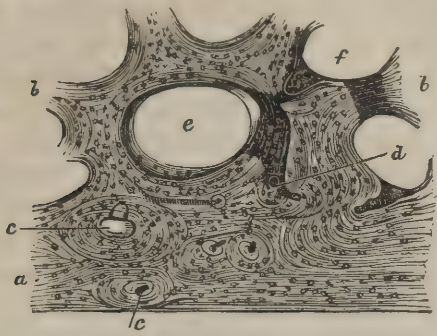
—These canals are filled with yellowish medullary or adipose matter, in which according to Miescher, are seen many minute capillary vessels, when successfully injected after the method of Krause.

* De pentiori ossium structura observationes. Vratislaviæ, 1834.

† De ossium genesi, structura et vita. Berolini, 1836.

‡ Fig. 4. Is a longitudinal section of a long bone, magnified one hundred times. *a.* One of the longitudinal canals not fully exposed. *b. b.* Longitudinal canals. *c. c.* These canals partially cut across, so as to exhibit the concentric lamellæ which surround each one. *d. d.* Transverse canals joining the others. The straight lines near the margins of the cut, are the lamellæ divided in the direction of their length, which surround the canals. The spots seen are the bony corpuscles, not sufficiently magnified to render them distinct.

*Fig. 5.**



—In the transverse section, each of the orifices of the canals, Fig. 5, is seen surrounded by ten or fifteen concentric lines, which on examining the longitudinal section, Fig. 4, are found to be as many lamellæ running the whole length of the canal, and each about the $\frac{1}{480}$th part of an inch in diameter, according to the microscopical measurement of Deutsch. The spaces in the transverse section of the bone, not occupied by the longitudinal canals and their concentric lamellæ, are filled by other lamellæ, which form larger concentric rings round the great medullary cavity. The diameter of the canals of Havers, according to Miescher, varies from $\frac{1}{320}$th to $\frac{1}{828}$th of an English inch.

—In the flat bones the canals with their lamellæ, run parallel with the surface of the bone. In the long bones, the longitudinal canals are directed obliquely into the central cavity.

—In the lamellæ concentric to the canals, there is an appearance of dots or short lines, which do not occupy the whole thickness of each lamella, and which Deutsch, supposed to be

* Fig. 5. Is a transverse section of one of the flat bones of the cranium, magnified one hundred times. *a.* Compact substance or table of bone, expanding into diploe. *b. b. c. c.* Vasculo-medullary canals of the compact portion, cut across. *d.* Transverse communicating canals, between these and the larger canals or cellular cavities of the diploe. *e.* Diploic cells communicating with others at *f.* Diploic cells like the canals of the compact portion, are surrounded with concentric striæ or lamellæ, and are in fact only amplified vasculo-medullary canals. The spots upon the surface, are the bony corpuscles.

extremely minute tubes. Some of these dots or lines, see Fig. 5, appear to transverse more than one lamella, though the majority, as Miescher describes them, are very short, and appear like the separations between the granules of the cartilage of the bones, from which the calcerous portions had been removed.* The result of the observations of Miescher, is:

—1st. That the spongy structure of bones, is nothing but an amplification of the canaliculi, as is shown by Gerdy.

—2d. That the medullary canal, as shown by its formation and name, is provided for the purpose of union or anastomosis, between these enlarged canaliculi, and,

—3d. That therefore, the canaliculi, girdled with concentric lamellæ and containing a medulla, composed of a great body of vessels, is the primary element or form of the osseous tissue, which is subsequently more fully developed.

—Scarpa is therefore correct in saying that the solid parts of bone, are formed of the cellular structure in a more compacted state. The reticulated tissue, which forms a sort of link between the cellular substance and the medullary cavity, and the osseous filaments which project every where from the parieties of the cavity into the medulla, are the remains of the walls of the cells, the integrity of which is impaired in consequence of the enlargement of the orifices by which they communicate together.—

Of the Periosteum.

Bones are invested with a firm membrane denominated *periosteum*, which is of a fibrous texture, and in some places may be separated into different lamina. The external surface of periosteum is connected with the contiguous parts by cellular membrane; the internal surface is connected with the bone by a great number of fibres and blood-vessels. The orifices of these vessels become apparent, when the periosteum is separated from bones in the living subject.

* Subsequent microscopical observations, as will be shown further on, have confirmed this supposition of Deutsch.—P.

This membrane covers the whole bony surface, except those parts which are invested by cartilages, and the capsular ligaments of joints, those which are occupied by the insertion of tendons and ligaments, and the bodies of the teeth. It appears most intimately connected with the surfaces of spongy bones, and the extremities of the long bones. In a sound state it has very little sensibility; but in some cases of disease it appears to be very sensible; of course it must be supplied with nerves, although several expert anatomists have declared they could not trace them.

It is probable that the principal use of the periosteum is to transmit vessels to the bones for their nourishment; but death or exfoliation of the surface, does not always take place when the periosteum is removed from a portion of bone.*

—This membrane presents a polished, pearly white appearance, when examined in the recent bone. It has received different names according to the parts which it covers, though its structure is nearly uniform throughout. Thus, when it covers the exterior surface of the bones of the cranium it is called pericranium; when it covers the cartilages, perichondrium; and when it covers the bones with the exception of those of the head, periosteum.

—In infancy the periosteum is soft, thick, and spongy, and may be readily separated from the bones. In adult life it is more firm and compact, and is often so intimately united as to be detached with difficulty from the bones. In old age it is extremely dense, and becomes not unfrequently ossified at its internal surface. Its vascularity, which is at first rather obscure, also gradually increases as life advances, but in old age it again diminishes.†

Of the Internal Periosteum or Medullary Membrane.

—This membrane is particularly well marked in the cavities of the long bones, where it forms a thin, delicate, pellucid,

* Dr. Physick thinks that the periosteum frequently prevents the bones from participating in contiguous disease, as the pleura turns off an abscess in the parietes of the thorax from its cavity, or the peritoneum from the cavity of the abdomen.—H.

† Anat. Phys. and Diseases of Bones and Joints. By S. D. Gross, M. D.

vascular tissue, lining the sides of the cavities of the reticulated tissue, in which it forms vesicles, that contain the marrow. —The lining membrane of the cells in the spongy portion of the bones is still more delicate in its structure, and more difficult of demonstration, and has been supposed by many anatomists to be formed only from the coats of the blood-vessels which anastomose thousands of times with each other in the interior of these bones. Its office, however, is precisely similar to that of the membrane in the cavity of the long bones, to lodge the fatty or medullary matter which is furnished by exhalation. It is very inflammable, burning with a beautiful blue tinge, and an oily disagreeable odour, fluid during life, but presents itself after death, under the form of brilliant granules of solid fatty matter. When death has taken place from some wasting disease as dropsy or consumption, the fat is removed by absorption, and its place is supplied by a watery fluid which renders the bones less greasy and more valuable as cabinet preparations. This medullary substance as has been before observed is also found with the vessels in the canals of the compact portions of bone.—

At the extremities of the long bones, the formina for the transmission of the blood-vessels and fibres are much larger than they are in the middle; but there is an oblique canal near the middle of these bones, which transmits vessels to this membrane in the interior of the bones called nutritious or medullary.

The surface of the internal cavities and cells of bones it will then be seen, is lined by a membrane more delicate and more vascular than the periosteum, which contains the medullary matter that is always found in their cavities. [This is the internal periosteum or the medullary membrane of the bones. M. Portal denies that it exists as a distinct membranous sac, but asserts, that it is derived from the envelope of the vessels which is sent in along with them from the periosteum.]

It has been said that in some circumstances this membrane has had great sensibility, but the reverse is the case in common.

The medullary matter in the large cavities of bones has a strong resemblance to adeps. That which is in the cells, at the ends of the long bones, appears more fluid. In young animals it is slightly tinged with a red colour.

—The chemical properties of the adipose or medullary substance of the bones consist according to Berzelius of the following ingredients:

Pure adeps or marrow	96
Membrane and blood-vessels	1
Albumen Gelatine Extractive and peculiar matter Water	3
	100

—The character of this substance differs somewhat at the different stages of life; it is of a thin aqueous consistence and of a reddish colour in the infant; of the consistence and presenting after death somewhat the appearance of butter in the central cavities of the bones, and of a red semi-fluid appearance in the spongy tissue of the bones of the adult; in old age it has something of a rancid smell, and is of a deep yellow colour. The adeps of the bones was supposed at one time to contribute to the flexibility, tenacity, and nourishment of the bones, but it is now generally believed to be deposited upon the same principles, as fat in other parts of the body, when nutritive matter is superabundantly elaborated by the digestive organs, and is held in reversion, as an aliment for the future wants of the economy, during temporary inanition from sickness or other causes.

—The deposit of fat in bones is not universal among animals. In birds the central cavity of the long bones, is filled only with air which is introduced into them from the lungs, and serves greatly to diminish their specific gravity, and facilitates their evolutions in the atmosphere.

—It is found in great quantity in the bones of the head of the *physeter macrocephalus*, or sperm whale, far out of the pro-

portion required, if its object only was that of nourishing the bones.

—Its purpose in this animal, besides being a deposit of aliment in reserve, is believed to be that of buoying up its head to enable it to respire with greater freedom.—

Cartilages and their Structure.

Cartilages are white elastic substances, much softer than bones, in consequence of a smaller quantity of earth entering into their composition.

Their structure is not so evidently fibrous as that of bones; yet by long maceration, or by tearing them asunder, a fibrous disposition is perceptible.

In articular cartilages their fibres are parallel to each other, and directed towards the cavities of the respective joints.

Their vessels are extremely small, though they can be readily injected in cartilages where bone is beginning to form. The vessels of the cartilages of the joints, however, seem entirely to exclude the red blood; no anatomist having yet been able to inject them. They have no cancelli, nor internal membranes, for lodging marrow; no nerves can be traced into them; nor do they possess any sensibility in the sound state.

Upon their surface, there is a thin membrane termed perichondrium, which in cartilages supplying the place of bone, as in those of the ribs or at the ends of long bones in children, is a continuation of the periosteum, and serves the same general purposes to cartilage as this does to bone.

Upon the surface of articular cartilages, the perichondrium is a reflection of the inner surface of the capsular ligament, and is so very thin, and adheres so closely, as to appear like part of the cartilage itself.*

One set of cartilages supplies the place of bone, and by their flexibility admit of a certain degree of motion, while their

* The articular cartilages are the only ones not provided with a fibrous perichondrium. The synovial membrane which is supposed to be over them from the inner face of the capsular ligament, is said to supply the place of perichondrium.—P.

elasticity recovers their natural position, as in the nose, larynx, cartilages of the ribs, &c.

Another set, in children, supplies the place of bone, until bone can be formed, and affords a nidus for the osseous fibres to shoot into, as in the long bones of children.

A third set, and that the most extensive, by the smoothness and lubrication of their surface, allow the bones to move readily, without any abrasion, as in the cartilages of the joints.

A fourth set supplies the office both of cartilage and ligament, giving the elasticity of the former and the flexibility of the latter, as in the bones of the spine and pelvis.

—Next to the bones, the cartilages form the hardest tissue in the body. On first inspection they do not appear to present any sort of internal organization. They appear homogenous in their texture and inorganic. When more carefully inspected, however, and especially in the articular cartilages, a particular structure is apparent.

—According to De Lasone and Hunter, the articular cartilages are composed of fibres implanted perpendicularly to the surface of the bones, and parallel with each other, like the villi or threads upon a piece of velvet. In this manner the cartilages covering the bones forming the joints, supposed to be invested with the synovial membrane, rub against each other, not upon the sides, but upon the ends of the fibres, which brings the elasticity of the latter into play. The perpendicular direction of these fibres may be made apparent by maceration, or by sawing down a recent bone, and splitting through its cartilage—and they are believed by Beclard, to constitute the free numerous and floating flocculi, which are seen on the surface of cartilage in its transformations from disease.

—It is very probable that there is some cellular tissue in the composition of cartilages: when carefully incinerated, the remains present a cellulated appearance. Its existence is rendered still more probable, from the cartilages being developed in the fœtus in a mould of cellular tissue; and from fleshy granulations, having been seen occasionally to spring from the surface of some

of them in various parts of the body, though not from the articular.

—When a recent cartilage is cut, a whitish juicy fluid is seen to exude from its substance, which must get into it, by imbibition from the surrounding parts, or as has been thought more probable, be carried into it, by white vessels, too small to admit more than the serous portions of the blood. If inflammation take place, which is admitted in many cartilages, though not as yet proven to exist in those of the joints, it differs from ordinary inflammation as these vessels are never so dilated, as to admit the red globules, and present a red appearance. No lymphatics have ever been traced into them, though Mascagni was disposed to consider them as formed entirely of these vessels; nor have nerves been found in them, the very existence of which in these parts, though so necessary to the perfection of other organs, would have unfitted them for their office. Hence we find them smooth, so as to move upon one another without friction, destitute of nerves, so as to bear pressure without sensation, and feebly supplied with vessels, so as to be little prone to inflammation, if they be not, as Gerdy has suggested, a mere secretion like the hair and nails. Hence they are enabled to bear exposure to the air for a considerable time without change, as stated by Velpeau, and to exist unharmed frequently in the midst of gangrene.

—According to J. Davy, their chemical composition is 55. parts in the hundred of water, 44.5, of albumine, and .5 of phosphate of lime. As in the bones, however, the chemical proportions vary at the different periods of life. They are nearly fluid in the fœtus, contain a large amount of fluid in youth, have the proportions given above at puberty, and a much larger amount of earthy matter in old age. In fact, with some few exceptions in the joints, they all have a natural tendency to ossify as life advances.

—The structure of cartilage is, however, not fully understood; that they share in some manner in the general circulation of the body, is rendered probable by their being coloured yellow in jaundice; and that they are not reddened when an animal is

fed upon madder like the bones, is said by Beclard, to be owing to the small quantity of phosphate of lime which they contain, and with which this colouring matter only has affinity. They participate too in the ulcerative process in many parts of the body, as in those of the nose, and as I have many times seen, in those of the larynx and trachea.

—All cartilages are divided into two classes, *temporary*, or ossescent, and *permanent*, a distinction which though not perfectly exact, is nevertheless very convenient for the purposes of study. The temporary cartilages, *(cartilag. temporariæ)* are those employed in the developement of the bones, those of which the models of the bones are all formed in the fœtus, and which gradually as the infant advances in growth give place to bony matter. The substitution of bony matter for the cartilaginous, is completed about the period of puberty.

—The permanent cartilages *(cartilag. permanentes)* are developed at an early period of life like the former, but have little tendency to undergo ossification, and retain their cartilaginous character for the whole or the greatest part of life. These comprise, the articular and costal cartilages, those of the larynx, eustachian tube, auditory meatus, etc. Some of these have a stronger tendency than the rest to ossify, as those of the larynx and ribs, which are frequently found after the fortieth year of life, converted into bone.

Accidental developement of Cartilages.

—In almost every one of the different tissues of the body, cartilages have been occasionly met with, but in general only after the middle period of life, when from their having apparently no fixed laws of developement, they have been called *accidental.*

—1st. They are found in the form of plates of greater or less size, adherent by both surfaces to the membranes between which they are formed; in the arteries, where these plates are most frequently met with, they are attached on their inner surface to the serous lining membrane, and on their outer to the middle coat of the vessel.

—2d. They are frequently met with in the form of roundish or irregular masses in the substance of the different organs, as the arteries, lungs and ovaries.

—3. Under the form of smooth flattened concretions, formed originally according to Meckel on the outer side of the synovial membrane of the joints, and which develope themselves towards the centre of the cavity of the joints, till their attachment to the membrane is stretched out, so that it becomes a mere pedicle, which not unfrequently breaks off. In this way is formed the loose cartilages often met with in the knee joint.

—All these accidentally developed cartilages have a tendency to be converted into bone, and which are then called accidental ossifications.—

Of the Formation of Bone.

The generality of bones, and particularly those which are long, are originally formed in cartilage; some, as those of the skull, are formed between membranes, and the teeth in distinct bags.

When ossification is about to begin in a particular part of a cartilage, most frequently in the centre, the arteries, which were formerly transparent, become dilated, and receive the red blood from which the osseous matter is secreted. This matter retains, for some time, the form of the vessels which gave it origin, till more arteries being by degrees dilated, and more osseous matter deposited, the bone at length attains its complete form.

During the progress of ossification, the surrounding cartilage by degrees disappears; not by being changed into bone, but by an absorption of its parts, the new-formed bone occupying its place.

The ossification of broad bones, as those of the head, begins by one or more points, from which the osseous fibres issue in rays, as seen in Fig. 6.

The ossification of long bones, as in those of the extremities, begins by central rings, from which the fibres extend towards the ends of the bones.

Fig. 6.*

The ossification of spheri-formed bones, begins by one nucleus, as in the wrist; and that of irregularly shaped bones by different nuclei, as in the vertebræ.

Some bones are completely formed at the time of birth, as the small bones of the ear.

The generality of bones are incomplete until the age of puberty, or between the fifteenth and twentieth year, and in some few instances until a later period.

In children, many parts of bones, particularly the ends of long bones, are distinct from the bodies; they are called epiphyses, and can be readily separated from the bodies of bones, by boiling, or by maceration in water.

The epiphyses begin to appear after the body of the bone is ossified, and are themselves ossified at seven or eight years of age, though their external surface is still somewhat cartilaginous.

They are joined to the body of the bone by the cartilages, which are thick in children, but gradually become thinner as ossification advances, till at last, in the adult, the external marks of division are not to be seen, though frequently some mark of distinction may be observed in the cancelli.

—The developement of bones is the final result of several successive changes. In the fœtus the bone is at first represented, by a soft gelatinous mass, continuous throughout as one piece, and in which there is no appearance of joints. The consistence of this matter gradually increases, and presents a cartilaginous appearance, about the second or third months of fœtal life. At the same period a separation is manifested at the place of the joints. A third change takes place in the cartilage, which is that of ossification; this commences in some of the bones, between the second and third months of fœtal life, at various

* Parietal boss of the infant at birth magnified, showing the central point of ossification. At first sight the vascular canals, resemble radiated lines, but with a little attention, they will be found to be vascular channels, slightly tortuous, and originating near the centre of the boss or protuberance from the foramina in the newly formed bone.—P.

periods in other bones, in many not till long after birth, and is not completed in all the bones of the body till near the period of puberty.

In the metamorphosis of cartilage to bone, the white and homogeneous cartilage which forms the mould of the bone, becomes hollowed out so as to present irregular cavities,* which subsequently form canals lined by a vascular membrane and filled with a viscous fluid, which extend to the centre of its structure. One of these canals forms subsequently the nutritious foramen. The cartilage becomes opaque and yellowish round this spot, the vessels convey red blood, numerous red points are formed in the structure, and ossification commences at the centre of the bone; never upon the surface. In the long bones a bony ring is first formed in the centre, and the vascular canals extend themselves in the direction of the extremities—in the flat and thick bones, in radii, attended by a redness in the cartilage, nearest the seat of ossification, and a diffused yellowness beyond it. From these canals the ossific material is deposited, and the central point of ossification grows, till the bone is completed. As the bony portion advances in growth, its redness diminishes, and the vascular canals which are at first large, decrease in size, so as to become in the adult bone microscopical. The ossescent or provisional cartilage of the bone, is solid and has in no instance any cavity in its centre. The ring of bone which, as before observed, is the first step of developement in the long bones, has a cavity in its centre which is subsequently destined to lodge the medulla. In the flat bones, and especially those of the cranium, ossification commences between the second and third months of fœtal life. Those of the cranium are formed between the pericranium and dura mater, and their cartilaginous mould is so thin and soft, that Howship and Beclard have denied its existence. The vascularity commences in them at a central

* According to the German anatomists, see page 44, the hollowing of these canals, is produced by an aggregation of the cartilaginous corpuscles into a series of linear ranges, between which the vessels shoot that convey the earthy material of the bone.—P.

point, and the ossific rays pass off in a straight direction, as seen in Fig. 6, page 41.

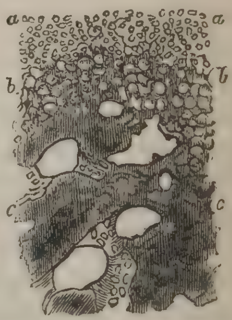
—Many of these bones, as well as of those in other parts of the body, are of such irregular shape, as to be incapable of being formed of fibres radiating from a single centre; they are, therefore, developed from several centres, the rays of which finally meet and inosculate. The developement of the thick bones, and the epiphysis of the long bones, take place in accordance with the same laws.

—*Growth of Bones.* In all the long bones, the extremities or epiphyses, are developed in separate pieces and between them and the ossified shaft there is a cartilaginous lamen, which does not disappear till the bone has attained its full developement. The bones increase in length by the continuous deposit of new ossific matter in this lamen of cartilage, which seems retained there as a soft bed for that purpose. As soon as the bone has attained its full length at puberty, the lamen disappears, and the epiphysis and shaft are consolidated, as seen in Fig. 3, where 2 is the layer of the cartilage, beginning to disappear at one point. The long bones increase in diameter, by the successive addition of new bony matter between the periosteum and bone. It is said to be deposited from the periosteum itself: but that opinion is incorrect, for no membrane can form a tissue, so much at variance with its own structure. It is the blood-vessels which merely ramify minutely through the periosteum, that deposit the matter upon the surface of the bone, precisely as they do in the centre. This mode of growth in diameter by concentric circles, has been proved by experiments made with mixing madder at intervals in the food of animals, by Duhamil,* Hunter, Professors Horner, Mussey, myself, and others. On killing the animals, red rings were found surrounding the bones, alternated with white ones corresponding to the periods of

* Duhamil who was no anatomist, considered the growth of bones, as analogous to the vegetation of plants. He placed a silver ring upon the bone of a young animal, which he afterwards fed interruptedly on madder. The white and red strata alternately covering the ring as he found on killing the animal, he erroneously considered not deposited on the outer surface, but formed by the expansion of the bone bulging over it as takes place in plants.—P.

administering or suspending the madder.* At the same time, that there is this increase of matter on the surface, there is a corresponding enlargement in the central or medullary cavity, which is said to be effected by the action of the absorbents. It appears to me, however, to be far more likely due to an interstitial growth, by which the walls of the cavity are increased in dimensions and the cavity itself necessarily enlarged. —*Corpuscles.* Purkinje has recently discovered in cartilage generally, and especially in the cartilage of bone, rounded corpuscles, which are much larger in diameter than the transverse sections of the canals described in p. 30. The existence of these corpuscles, has also been confirmed by the microscopical researches of Deutsch, Miescher and Sharpey; according to Miescher they correspond with the brown spots described by Lewenhoeck as his second order of foramina. In bone deprived of its earthy parts by maceration in acid, their appearance is that of small brown spots,‡ pellucid in the centre, and surrounded with a distinct opaque line, which by a high magnifying power, appeared to Miescher to be denticulated. They are situated between their lamellæ, the long diameter being ob-

Fig. 7.†



* Rutherford, of Edinburgh, first explained this colouring of the bone, without that of the other tissues, by the affinity of the madder for the phosphate of lime, upon which it acted as a mordant.—P.

† Fig. 7, is a representation from Miescher of the progress of ossification, caused by inflammation in an adult bone, which takes place precisely in the same manner that new bone is formed; *a a*, the cartilage, the first stage in the formation of bone, and the small bodies thickly interspersed through it are the cartilage corpuscles of Purkinje; *b b*, the first or primary stage of the bony structure, in which the osseous corpuscles arrange themselves somewhat into lines, and the bony fibres shoot in between them, and in the thickness of the corpuscles themselves saline particles are deposited, which renders them opaque; *c c*, the new structure completely ossified.

‡ These as shown p. 46, are now believed to be new bodies, bony corpuscles, which supplant the corpuscles (cartilaginous) of Purkinje. The above account is retained in order to show progressively the history of the discovery.

lique in regard to the direction of the lamellæ, and when the work of ossification has not commenced, appear to have no fixed arrangement, and are wedge-shaped, oval, oblong, or flattened, see Fig. 8. Of the nature of these corpuscles, little is positively known. Neither vegetable or mineral acids have any effect upon them, except to render them a little more prominent on the surface of a section of cartilage. Alcohol, ether, or a cold solution of caustic potash does not change them; but if exposed to a hot caustic solution, or a long time macerated in water they become completely liquified.

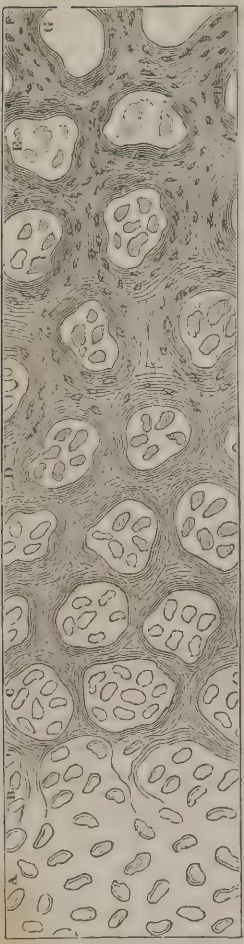
—The size of the corpuscles according to the measurements of Miescher, varied in length from the 0.0048 to the 0.0072 parts of a line, and in breadth from the 0.0017 to the 0.0030. The researches of this anatomist, of Müller, and other recent observers, have shown that the formation of cartilage always precedes that of bone,* and that each ossescent or temporary cartilage, is an organic tissue, homogeneous, more or less pellucid, elastic, in its first state almost colourless, afterwards assuming a bluish cast, and having a great many peculiar minute corpuscles interspersed through its substance, as shown by the microscope. In the conversion of cartilage into bone, the change first commences in the cartilage that surrounds the corpuscles.

—Weber, Beclard and others, believe that the calcareous matter is deposited by the vessels, in the cartilaginous mould of the bone, as a foreign body, and that the cartilaginous particles are removed in proportion to make room for it; but this is a mere opinion which has not been proven.

—Miescher, asserts that he was unable even with the microscope to ascertain in what manner, the calcareous particles were received into the cartilage, the strongest powers of the micro-

* This which was admitted by Albinus, Haller, Scarpa, and others, has been denied by Howship and Beclard, in regard to the diaphysis of the long bones, and the bones of the cranium. In the bones of the rabbit, Miescher found a mould of cartilage before a particle of ossific matter had been deposited, and between the pericranium and dura mater, a thin stratum of cartilage. An exception must be made however in regard to certain flat bones of the human skull, as the parietal.—P.

Fig. 8.*



scope exhibiting no cells in which they were placed, nor any calcareous particles of the size of the dispersed corpuscles; all that appeared positively was that the cartilage seemed by degrees to assume the aspect of bone.

The more recent researches of Gerber,† have given if not a perfectly clear, at least a more satisfactory explanation of the manner in which the ossific cartilage is so modified, as to form bone. The primitive physical formation of all cartilage is cellular, that is they grow from cell-germs, as is the case with the other tissues of the body. These cell-germs or cartilage corpuscles are seen at A. Fig. 8, magnified 250 diameters. Between these cells and filling up the vacant spaces between them, is an amorphous, *hyaline* or *transparent intercellular* substance; the cells themselves are filled with a softish granular matter. As the cartilage increases in growth, new cells are developed in the hyaline substance by which the older ones are pushed farther and farther from each other. The original cells produce two or more young or secondary cells by the developement of their granular nuclei: between these secondary cells is also formed a secondary hyaline substance, and thus the original cells form each one a little group of cells enclosed within itself, and to each group the name

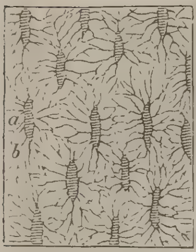
* Fig. 8. Ascheme intended to represent cartilage in the progressive stages of ossification, magnified 250 diameters. A. Cartilage with the regularly disseminated corpuscles of Purkinje—cellular cartilage. B. The corpuscles when ossification has begun, are forced into groups, between which the hyaline cartilage is transformed into bone cartilage. This bone cartilage has now undergone a change, so as to be chemically dif-

† Elements of General and Minute Anatomy by T. Gerber. London, 1842.

of cartilage corpuscle is still applied. This is the common embryonic constitution of cartilage. The fixed character of the cartilage depends upon the after changes which take place in it. If fibro-cartilage be formed, the intercellular or hyaline substance is developed in the form of fibres and the cells disappear altogether. If elastic cartilage, fibres are developed around the cells forming a kind of network. If ossific cartilage, the hyaline substance takes on a stratified arrangement round the cartilage cells, and in it a new set of corpuscles are developed, called the bone corpuscles, that are the nuclei of the bone cells, see Fig. 9, of which the microscope has shown in reality all bony structure to consist. As this process is commencing, the cluster of cartilage cells called cartilage corpuscles, become compressed together. The secondary hyaline substance becomes dissolved, transudes through the walls of the parent cell, coagulates round it, and in this state of *cytoblastema* as it is called—this basis structure for the growth of other parts—it constitutes the proper ossific cartilage. In it arise the bone corpuscles, called *cytoblasts* or germs, from which are formed the bone cells. These follow the same mode of developement, as the embryonic cartilage cells: that is new corpuscles are forming in the cytoblastema, while those recently produced are growing; the cartilage corpuscles ever more closely compressed together disappear; radiated points, nutrient vessels, etc. make their appearance, the nuclei of the bone cells, (corpuscles,) and the cells themselves when completely formed receive deposits of calcareous salts, and the formation of bone is achieved.

ferent from those cartilages which are to remain flexible during life. It does not on boiling yield gelatine like them, but a substance called chondrin, which differs from gelatine in not being precipitated by tannic acid, etc. C. The groups of cartilage corpuscles are now seen completely inclosed by bone cartilage. D. The cartilage corpuscles are here rendered less transparent by the process of resolution that is going on; the bone corpuscles are at the same time making their appearance in the bone cartilage. E. The cartilage corpuscles are dissolved and partially removed. F. The cartilage corpuscles have disappeared; have been absorbed. G. In spongy bones, the spaces occupied by the cartilage corpuscles remain as cells filled with globules of fat. In compact bones the cells are reduced to minute canals, by the growth of bony matter, or they disappear entirely. In Fig. 9, there is a representation of bone in its perfectly formed state, magnified 450 diameters, and representing the bone cells or corpuscles, with their calcareous canals.

Fig. 9.*



It is according to this from a peculiar substance, not ordinary cartilage, that bone is produced, and we now know that the effused fluid of which the callus in fractures is formed, is in some respects different from the cartilaginous mould of bone, and that in fact bone is developed in many parts of the body, as in the human skull for instance, without the existence of any previous cartilaginous basis.

Formation of Callus.

—The most ancient opinion entertained in regard to the mode of union between broken bones, was, that it was owing to the concretion of a viscous fluid, or imaginary osseous juice poured out between the fragments. This was the opinion of Haller. Duhamil demonstrated the fallacy of this belief, by numerous experiments, and instituted a theory of his own which is much nearer the truth. According to him the production of callus or new bony matter, is owing to the swelling, elongation, and subsequent adhesion between the periosteum and medullary membrane of one fragment with the corresponding parts of the other; and that from *these membranes* thus modified, bony matter was deposited in the form of a ring on the exterior of the bone and a plug in its medullary cavity, which held the fragments together by passing across the cavity of fracture, and sometimes by prolongations passing between them through the cavity. John Hunter believed that the re-union of fractured bones took place from the organization of the blood effused around the fracture and between the fragments; a doctrine which now has few supporters.

—The credit of giving the most faithful account of the forma-

* Fig. 9. Bone corpuscles, *a*, magnified 450 diameters, which have here been converted into bone cells. *b*. Branches of the bony cells which by their inosculations form a net work. They are called by Müller the canaliculi calicophori. It is not yet fully decided whether or not the cells and their branches are filled with calcareous matter, or merely incrusted with it. The diameter of these calcigerous canals (canalic. calicoph.) is reckoned at their largest parts to be between one fourteen thousandth and the one twenty thousandth part of an inch.

tion of callus, is due to Dupuytren* and Sanson. According to these, the union of fragments of bone, is effected by the formation of two successive stages of callus. One which is *provisional* or *temporary*, is completed usually in the space of thirty or forty days, by the union and ossification of the periosteum, cellular tissue, and even in some cases of the muscles, so as to constitute an external ring—and of the medullary membrane, so as to constitute an internal plug. The other, which he calls *final* or *permanent*, is formed by the reunion of the surfaces of the fracture, with a solidity so much superior to that of the bone in other parts, that it will break any where again, rather than at that point, and which is never fully completed under eight, ten, or twelve months, by which time all the provisional callus has been removed, and the medullary canal is completely re-established.

—Dupuytren divides the successive organic changes, which attend the formation of callus, into *five periods*.

—The *first period*, extends from the time of the fracture to the eighth or tenth day, and is characterised by the following phenomena: the medullary membrane, the medulla, the periosteum, cellular tissue, and sometimes the muscles themselves, are torn at the time the fracture takes place; blood escapes from the ruptured vessels, surrounds the fragments, spreads in the medullary canal and infiltrates in the surrounding tissue: the hemorrhage stops; a slight inflammation is developed in all these parts, which is the first step towards the production of the callus. The cellular tissue surrounding the bone, becomes very vascular, is thickened, loses its elasticity, and acquires a great degree of consistence; it sends irregular processes into the neighbouring muscles, transforms them to a greater or less extent into an analogous tissue, and unites them in a common structure with the periosteum, which is also much thickened and very vascular. A nearly similar change takes place in the cavity of the bone in respect to the medulla and its membrane. The calibre of the medullary canal is contracted by the thickening of the membrane, which presents a fleshy appearance, in con-

* Journal Univ. de Med. tom. 20.

sequence of a sort of gelatinous infiltration. The effused blood becomes absorbed, and a ropy, viscous, gelatinous fluid, is poured out between the ends of the fragments, which is essential to the production of the *permanent* callus.

—The *second period* extends from the tenth or twelfth, to the twentieth or twenty-fifth day. During this period, the engorgement of the surrounding parts diminishes and the muscles are liberated: but the cellular tissue remains condensed and concentrated round the fracture, presenting grooves or even canals to the tendons of the muscles if any pass in the vicinity of the fracture, in which they are able to play, though with little freedom, in consequence of some existing induration of the cellular tissue. This constitutes the provisional *callus*, the external portion of which is thickest at the place of fracture, and insensibly terminates upon the fragments of bone. Its internal portion is formed by the periosteum, which is closely attached to the bone. Its structure is whitish, homogeneous, and of a cartilaginous or fibro-cartilaginous character. The medullary membrane forms a similar plug of provisional cartilaginous matter, which fills up the whole cavity of the bone, above and below the place of fracture. The viscous or gelatinous fluid interposed between the ends of the bones, is now rose-coloured or red, presents sometimes a flocculent appearance, and is adherent by its margins to the external and internal callus. The limb may still be bent at the place of fracture, but no crepitation can be produced.

—The *third period* extends from the twentieth or twenty-fifth day, to the thirtieth, fortieth or sixtieth, according to the age and health of the patient.

—Ossification commences in the centre of the cartilage, and by degrees the whole tumour, internal and external, becomes osseous. It is very vascular, and Howship* has succeeded in injecting the vessels. If at this period the bone be cut longitudinally, the provisional callus will be found presenting all the characters of spongy bone, while the fragments will be found

* Microscop. Observ.

movable upon each other, the substance poured out between them, not having apparently undergone much change.

—The *fourth period* extends from the fiftieth or sixtieth day, to the fifth or sixth month. During this period the callus has been changed from the state of spongy, to that of compact bone.

—The substance intermediate to the fragments, which presented itself under the form of a line or septum between them, becomes more consistent, presents a whiter hue, and is ossified towards the end of this period; and the permanent callus is now completed.

—The *fifth period* extends from the fifth or sixth, to the eighth, tenth or twelfth month, during which time the whole of the provisional callus is entirely removed, the object of its formation having been effected, that of securely holding the bones together like splints till the fractured surfaces become firmly reunited. The periosteum resumes its usual thickness and polish, and the muscles and tendons their entire freedom of motion.

—The internal plug of callus having been removed by absorption, the central cavity of the bone, the medullary membrane and the marrow itself, present their usual appearance.—

Of the Terms used in the Description of Bones and their Articulations.

The study of this subject has been rendered more difficult by the unnecessary introduction of many hard words, but some of these words are so generally used, that they ought to be understood by the student of anatomy.

The word *process* signifies any protuberance or eminence arising from a bone.

Particular processes receive names from their supposed resemblance to certain objects; and their names are very often composed of two Greek words; thus the term *coracoid*, which is applied to a well-known process, is derived from the Greek words κοραξ,, a crow, and ειδος,, resemblance.

If a process has a spherical form, it is called a *head*. If the head is flattened on the sides, it is denominated a *condyle*.

A rough protuberance is called a *tuberosity*. A ridge on the surface of a bone is called a *spine*.

The term *apophysis*, is nearly synonymous with process. It signifies a protuberance that has grown out of the bone, and is used in opposition to the term *epiphysis*, which signifies a portion of bone growing upon another, but distinct and separable from it; as is the case in infancy with the extremities of the long bones.

The cavities on the surfaces of bones are named in the same way, as will appear by a reference to the glossary at the end of this work.

Words of this kind have been used most profusely in the descriptions of articulations, and here also their utility is doubtful. Therefore, for many terms used on this occasion, the reader is referred to the glossary; but the following are necessary to be understood.

SYMPHYSIS does not merely imply the concretion of bones originally separate, as its derivation imports; but it is understood also to mean the connexion of bones by intermediate substances. Thus, there are three species of symphysis, particularly noticed, viz.

Synchondrosis, when bones are connected to each other by cartilage; as the ribs and sternum.

Synneurosis, when they are connected by ligaments, as in the movable articulations.

Syssarcosis, when they are connected by muscle. The different articulations are of two kinds, viz. *Synarthrosis* and *Diarthrosis*.

SYNARTHROSIS is the name of that kind of articulation which does not admit of motion. There are three species of synarthrosis, viz.

Suture, when the indented edges of the two bones are received into each other, as is the case with the bones of the cranium.

Gomphosis, when one bone is fixed in another like a nail in a board, as the teeth in their sockets.

Shindylesis, when the thin edge of one bone is received into a narrow furrow of another, as the nasal plate of the ethmoid in the vomer.

DIARTHROSIS is the name of that kind of articulation which admits of motion. Of these articulations there are three species, viz.

Enarthrosis, when a large head is received in a deep cavity, as the head of the thigh bone in the acetabulum.

Arthrodia, when the head is connected with a superficial cavity.

Ginglimus, when the extremities of bones apply to each other so as to form a hinge.

But most of the important joints have so many peculiarities that they cannot be understood without studying them separately. It may, therefore, be doubted whether the classification and arrangement of joints is any way necessary.

—Some of the more common anatomical terms are explained in this place and in the glossary; but they have now become too numerous, in consequence of the introduction of a multitude of new ones, some of which are of foreign origin, to be separately defined in this work. A medical dictionary will better serve the purposes of the student. That of Prof. Dunglison,* will be found the most comprehensive and useful.

* Medical Lexicon—A new Dict. of Med. Science. 3d edit. by Robley Dunglison, M. D., Prof. Inst. Med., &c., in Jeff. Med. Coll. Lea & Blanchard. Phil. 1842.

CHAPTER II.

Of the skeleton and its different parts, and the individual bones of which they are composed.

The bones of an animal arranged and connected to each other in their natural order, separate from the soft parts, compose a skeleton.

The skeleton is said to be natural when the bones are connected by their own ligaments, which have been allowed to remain for that purpose.

It is called artificial when the bones are connected with wire, or any foreign substance.

The artificial skeleton is best calculated for studying the motions of the different bones, because the dry and hard ligaments of the natural skeleton do not allow the bones to move; but the bones of young animals do not admit of the preparation necessary for an artificial skeleton, as their epiphyses would separate, and they are therefore formed into natural skeletons.

The study of the skeleton and its mechanical properties, as a piece of machinery, is absolutely necessary to a perfect understanding of many motions of the body, and of the action and co-operation of muscles; but any observations on this subject will be better understood after the individual bones and the muscles have been described.

The *skeleton* is divided into the *head,* the *trunk,* the *superior* and the *inferior extremities.*

Of the Head.

The Head comprehends the Cranium, and Face.

The *cranium* consists of eight distinct bones, which, when placed in their natural order, form a large spheroidal cavity for containing the brain, with many foramina or apertures that communicate with it.

These bones are of a flattened form. They are composed of two lamina or plates called tables, with a cellular structure between them, called meditullium, or diploe. The external table is more firm and thick than the internal. The latter is comparatively very brittle, whence it is called the vitreous table. [Between the two tables which compose the flat bones of the cranium and running through the diploe are several sinuses, which are occupied by veins in the recent subject. They were discovered by M. Fleury about forty years ago, while he was Prosector at the School of Medicine in Paris, and engaged in some inquiries relative to the structure of the cranium at the instigation of M. Chaussier. The account which M. Chaussier gives of these veins is as follows: they are situated in the middle of the diploe between the two tables of the skull, and like all other veins are intended to return the blood to the heart. They are furnished with small valves, have extremely thin and delicate parietes, and commence by capillary ramifications coming from the different points of the vascular membrane which lines the cells of the diploe. Their roots are at first extremely fine and numerous, form by their frequent anastomoses a kind of network, and produce by their successive junction, ramuscles, branches, and large trunks, which, becoming still more voluminous, are directed towards the base of the cranium. Some varieties exist in regard to the number, size, and disposition of these trunks, but generally one or two of them are found in each side of the frontal bone, two in the parietal bone, and one in each side of the occipital bone. Anastomoses exist between these several trunks, by which the veins in the parietal bone are joined to those in the frontal and in the occipital. Branches from the right side of the head also anastomose with some from the left side. Besides the branches already mentioned, one or two smaller than the others are directed towards the top of the head and terminate in the longitudinal sinus.

The descending veins of the diploe communicate in their passage with the contiguous superficial veins, and empty into them the blood which they receive from the several points of

the diploe. These communications are produced through small foramina which penetrate from the surface of the bone to the diploe. The trunks of such diploic veins as are continued to the base of the cranium, open partly into sinuses of the dura mater, and partly into the venous plexus at the base of the pterygoid apophyses, and form there the venous communications called the emissaries of Santorini. Moreover, there are communications sent from the diploic veins through the porosities of the internal table of the skull to the veins of the dura mater. This fact is rendered very evident by tearing off the skull cap, when the surface of the dura mater will be studded with dots of blood, and the internal face of the bone also, particularly in apoplectic subjects. It appears indeed that the arteries of the cranium are principally distributed on its external surface, and the veins on its internal surface and diploe.

In the infant the diploic veins are small, straight, and have but few branches: in the adult they correspond with the description just given; and in old age they are still more considerable, forming nodes and seeming varicose. In children, when the bones are diseased, they partake of the latter character. In order to see them fully, the external table of the skull must be removed with the chisel and mallet, both from its vaults and base.]*

The *periosteum*, which is on their external surface, is called *pericranium*. Internally the *dura mater*, or membrane which covers the brain, supplies the place of periosteum.

There are eight of these bones, which are thus denominated: *Os Frontis*, *Ossa Parietalia*, *Ossa Temporum*, *Os Occipitis*, *Os Sphenoides*, and *Os Ethmoides*. The two last are called common bones, to denote that they are connected with the bones of the face as well as with those of the cranium.

The os frontis forms the whole fore part of the vault of the

* The diploe, or meditullium, corresponds exactly in structure and situation with the spongy, or cellular tissue of the other bones of the body, though it has unnecessarily received a distinct name. Neither are the diploic sinuses peculiar to the bones of the skull. They are found presenting exactly the same appearance in the bodies of the vertebræ, and appear in fact to be but a developement of the canaliculated tissue of the other bones. See Fig. 5, page 30.—P.

cranium: the two ossa parietalia form the upper and middle part of it; the ossa temporum compose the lower part of the sides; the os occipitis makes the whole hinder part and some of the base; the os ethmoides is placed between the orbits of the eyes, and the sphenoides extends across the base of the cranium.

The Sutures.

The above bones are joined to each other by five sutures; the names of which are the *Coronal*, *Lambdoidal*, *Sagittal*, and two *Squamous*.

The *coronal suture* is extended over the head, from within about an inch of the external angle of one eye, to the like distance from the other; which being near the place where the ancients wore their garlands, this suture has hence got its name. Though the indentations of this suture are conspicuous in its upper part, yet an inch or more of its end on each side has none, but is squamous and smooth.

The *lambdoidal suture* begins some way below, and further back than the vertex or crown of the head, whence its two legs are stretched obliquely downwards, and to each side, in form of the Greek letter Λ, and are now generally said to extend themselves to the base of the skull; but formerly, anatomists reckoned the proper lambdoidal suture to terminate at the squamous sutures: and the portion continued from them on each side, where the indentations are less conspicuous than in the upper part of the suture, they called additamentum suturæ lambdoidis.

This suture is sometimes very irregular, being made up of a great many small sutures, which surround a number of insulated bones, that are generally more conspicuous on the external surface of the skull than internally. These bones are commonly called *triquetra* or *wormiana;* their formation is owing to a greater than ordinary number of points of ossification in the skull, or to the ordinary bones of the cranium not extending their ossification far enough or soon enough; in which case, the unossified interstice between such bones begins a separate

ossification, in one or more points; from which the ossification is extended to form as many distinct bones as there were points which are extended into the large ordinary bones, and into each other.*

The *sagittal suture* is placed longitudinally, in the middle of the upper part of the skull, and commonly terminates at the middle of the coronal and of the lambdoidal sutures; between which it is said to be placed, as an arrow is between the string and the bow. This suture is sometimes continued through the middle of the os frontis down to the root of the nose.

The *squamous agglutinations*, or false sutures, are one on each side, a little above the ear, of a semicircular figure, formed by the overlapping (like one scale upon another) of the upper part of the temporal bones on the lower part of the parietal, where, in both bones, there are a great many small risings, and furrows which are indented into each other: though these inequalities do not appear until the bones are separated. In some skulls, indeed, the indentations here are as conspicuous externally as in other sutures; and what is commonly called the posterior part of this squamous suture, always has the evident serrated form; and therefore is reckoned by some a distinct suture, under the name of additamentum posterius suturæ squamosæ.

The *squamous suture* is not confined to the conjunction of the temporal and parietal bones, but is made use of to join all the edges of the bones on which each temporal muscle is placed; for the two parts of the sphenoidal suture, which are continued from the anterior end of the common squamous suture just now described, one of which runs perpendicularly downwards, and the other horizontally forwards; and also the lower part of the coronal suture already taken notice of, may all be justly said to pertain to the squamous suture.

* These ossa triquetra or wormiana are also frequently met with in the sagittal suture, and occasionally in all the different sutures of the cranium. As many as fifteen or twenty have been seen in a single head, though usually their number is much less. Where the cranium is of a globular form, few, and frequently none, are met with. They never begin to ossify till six months or a year after birth.—P.

This structure appears to depend upon the pressure of the temporal muscle externally, and the resistance of the brain within, which makes the bones so thin, that their edges opposed to each other are not sufficiently thick to stop the extension of their fibres in length, and thus to cause the common serrated appearances of sutures; but the narrow edge of the one bone slides over the other. The squamous form is also more convenient here; because such thin edges of bones, when accurately applied one to another, have scarce any rough surface to obstruct or hurt the muscle in its contraction; which is still farther provided for, by the manner of laying these edges on each other; for, in viewing their outside, we see the temporal bones covering the sphenoidal and parietal, and this last supporting the sphenoidal, while both mount on the frontal; from which disposition it is evident, that while the temporal muscle is contracting, which is the only time it presses strongly in its motion on the bones, its fibres slide easily over the external edges. Another advantage of this structure is, that the whole part is made stronger by the bones thus supporting each other.

The indentation of the sutures are not so strongly marked on the inside as on the outside of the cranium; and sometimes the bones seem to be joined by a straight line: in some skulls, the internal surface is found entire, while the sutures are manifest without. By this mechanism, there is no risk of the sharp points of the bones growing inwards, since the external serræ of each of the conjoined bones rest upon the internal smooth-edged table of the other.

The advantages of the sutures are these: 1. The cranium is more easily formed and extended into a spherical figure, than if it had been one continued bone. 2. The bones which are at some distance from each other at birth, may then yield, and allow to the head a change of shape, accommodated to the passage it is engaged in. Whence, in difficult parturition, the bones of the cranium, instead of being only brought into contact, are sometimes made to mount one upon the other.

[The sutures which unite the bones of the cranium, are

generally said to be made by the radii of ossification, from the opposite bones meeting and passing each other, so as to form a serrated edge. This explanation is however insufficient, for the following reasons: we always find the sutures in the same relative situation, and observing the same course in the cranium; if they, then, depended exclusively on so mechanical a process, as the shooting of the rays of bone across each other when they met, in ossification on one side of the head occurring sooner or faster than on the other, we ought to find the sagittal suture to one side of the middle line; it should also, in many instances, be found crooked. Moreover, in all cases where bones arise from different points of ossification and meet, particularly in the flat bones, the serrated edges ought to be formed; this, however, is not the case. The os occipitis, which is formed originally from four points of ossification, and has therefore as many bones composing it in early life, never joins these bones together by the serrated edge; the acromion process of the scapula is never united to its spine by sutures; the three bones of the sternum never unite by suture, and the same observation holds good in many other instances. Bichat, who rejects this mechanical doctrine, advances an opinion much better founded. The dura mater and the pericranium, before ossification commences, form one membrane, consisting of two lamina; it is generally known that the flat bones of the cranium are secreted between these two lamina; now the outline of each bone, long before it has reached its utmost limits, is marked off by partitions passing between these two membranes. The peculiar shape of the bony junction, or the suture in adult life, will, therefore, depend upon the original shape of the partitions: when the latter are serrated, the points of ossification will fill up these serræ; but when they are simply oblique, the squamous suture will be formed. This also accounts for cases where the mode of junction is intermediate to the squamous and serrated suture; for the formation of the ossa triquetra, and why in some skulls they do not exist, whereas in others their extent and number are very considerable. The inference will also be drawn from this, that in all ossi-

fications from different nuclei, where these original membraneous septa do not exist, a suture will not be formed; but the bones will join each other, as in a case of callus between the broken extremities of bones. When these septa become weak or thin, either from original tendency, as in the case of the sagittal suture, which in early life is continued to the root of the nose frequently; or from advanced age, as in the case of nearly all sutures, the bones of the opposite sides amalgamate, and no appearance of suture is left. It is easy to make a preparation illustrative of these facts, and one now exists in the museum of the University of Pennsylvania, in which, by removing the bone from between the membranes by means of an acid, and afterwards rendering the membranes transparent with oil of turpentine, the septa are seen sufficiently distinctly.]

Os Frontis.

The os frontis, as its name imports, forms the front part of the cranium, and the upper portion of the orbits of the eyes.

Fig. 10.*

The external surface of this bone is smooth at its upper convex part; but several processes and cavities are observable below; for at the angles of each orbit, the bone projects to form four processes, two internal, and as many external; which are denominated *angular*. Between the internal and external angular processes on each side, an arched ridge is ex-

* The external surface of the os frontis. 1. Frontal protuberance or boss of the right side. 2. The superciliary ridge. 3. Supra-orbital ridge. 4. External angular process. 5. Internal angular process. 6. Supra-orbital notch for the transmission of the supra-orbital nerve and artery; it is occasionally converted into a foramen. 7. The nasal or superciliary boss; the swelling around this point denotes the situation of the frontal sinuses. 8. The temporal ridge, commencing from the external angular process (4). The depression in which fig. 8 is situated is a part of the temporal fossa. 9. The nasal spine.

tended, on which the eyebrows are placed. Very little above the internal end of each of these *superciliary ridges*, a protuberance may be remarked in most skulls, called the superciliary or nasal boss, where there are large cavities within the bone, called *sinuses*. Between the internal angular processes, and in front of the vacuity for the ethmoid bone, the edge of the os frontis is serrated for articulation with the ossa nasi, and the process of the upper maxillary bone; and from the centre of this surface a small process arises, which is called the *nasal spine*. From the under part of the superciliary ridges, the frontal bone runs a great way backwards: these parts are called *orbitar* processes, which, contrary to the rest of this bone, are concave externally, for receiving the globes of the eyes, with their muscles, fat, &c.

In each of the orbitar processes, at the upper and outer portion of the orbit, a considerable sinuosity is observed, where the glandula lachrymalis is lodged. Near each internal angular process a small pit may be remarked, where the cartilaginous pulley of the superior oblique muscle of the eye is fixed. Between the two orbitar processes, there is a large vacuity which the cribriform part of the os ethmoides occupies. The frontal bone has frequently little caverns formed in it where it is joined to the ethmoid bone.

The foramina, or holes, observable on the external surface of the frontal bone, are three in each side.

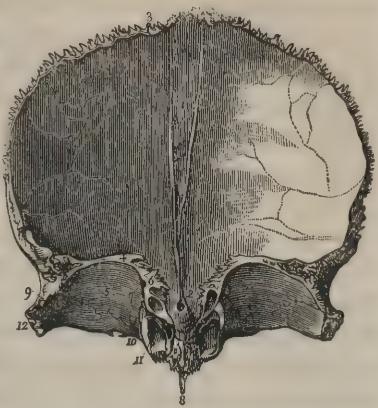
On each supra-orbital ridge, 3 fig. 10, at the distance of one-third of its length from the nose, is a foramen, or a notch, through which pass a branch of the ophthalmic artery and a small nerve called the supra-orbital.

In the internal edge of each orbitar process are two other foramina denominated *anterior* and *posterior orbitar*, or *ethmoidal foramina*, which lead to the nose: sometimes they are only notches or grooves which join with similar grooves in the bones below, and form foramina. They transmit the anterior and posterior ethmoidal arteries and veins, and the former transmits likewise the internal nasal branch of the ophthalmic nerve.

The internal surface of the os frontis is concave, except at

the orbitar processes, which are convex, and support the anterior lobes of the brain. This surface is not so smooth as the external; for the larger branches of the arteries of the dura mater make some furrows in its sides and back parts, and its lower and fore parts are marked with the convolutions of the anterior lobes of the brain. In the middle of the concave internal surface is a groove, which is small at its commencement, and gradually increases in diameter as it proceeds upwards. This is formed by the superior longitudinal sinus; at its commencement is a ridge to which the beginning of the falciform process of the dura mater is attached. At the root of this ridge is a small foramen, sometimes formed jointly by this bone and the ethmoid; it is denominated *foramen cæcum;* in it a small process of the falx is inserted, and here the longitudinal sinus begins.

Fig. 11.*



The frontal sinuses are formed by the separation of the two tables of this bone at the part above the nose and the internal extremities of the superciliary ridges. In the formation of these cavities, the external table commonly recedes most from the general direction of the bone.

* The internal surface of the frontal bone; the bone is raised in such a manner as to show the orbito-nasal portion. 1. The grooved ridge for the lodgment of the superior longitudinal sinus and attachment of the falx. 2. The foramen cæcum. 3. The superior or coronal border of the bone; the figure is situated near that part which is bevelled at the expense of the internal table. 4. The inferior border of the bone. 5. The orbital plate of the left side. 6. The cellular border of the ethmoidal fissure. The foramen cæcum (2) is seen through the ethmoidal fissure. 7. The anterior and posterior ethmoidal foramina; the anterior is seen leading into its canal. 8. The nasal spine. 9. The depression within the external angular process (12) for the lachrymal gland. 10. The depression for the pulley of the superior oblique muscle of the eye; immediately to the left of this number is the supra-orbital notch, and to its right the internal angular process. 11. The opening leading into the frontal sinuses. 12. The same parts are seen upon the opposite side of the figure.

These cavities are divided by a perpendicular bony partition, which is sometimes perforated and admits a communication between them. Their capacities are often very different in different persons, and on the different sides of the same person. In some persons whose foreheads were very flat, they are said to have been wanting. They communicate with the nose by means of a canal in the cellular part of the os ethmoides.

The os frontis is composed of two tables, and an intermediate diploe, as the other bones of the cranium are: it is of a mean thickness between the os occipitis and the parietal bones; and is nearly equally dense throughout, except the orbitar processes, where, by the action of the eye on one side, and pressure of the lobes of the brain on the other, it is made extremely thin and diaphanous, and the diploe is entirely obliterated. In this place there is so weak a defence for the brain, that fencers esteem a push in the eye mortal.

In such skulls as have the frontal bone divided by the sagittal suture, the partition separating these cavities is evidently composed of two plates, which easily separate.

Each of the frontal sinuses opens into one of the uppermost cells in the anterior part of the ethmoid bone, and this cell communicates with the middle channel of the nose under the anterior end of the *os turbinatum superius.*

This bone is united with the parietal, ethmoidal and sphenoidal bones of the head; and with the nasal, maxillary, unguiform and malar bones of the face.

Ossa Parietalia.

Each of the two *ossa parietalia* is an irregular square; its upper and front edges being longer than the one behind or below. The inferior edge is concave, the middle part receiving the upper round part of the temporal bone. The angle formed by the under and anterior edges is so extended as to have the appearance of a process.

The *external surface* of each os parietale is convex. Upon it, somewhat below the middle height of the bone, there is a

Fig. 12.*

transverse arched ridge, generally of a whiter colour than any other part of the bone; from which, in bones that have strong prints of muscles, we see a great many converging furrows, like so many radii drawn from a circumference towards a centre. From this ridge of each bone the temporal muscle rises: and, by the pressure of its fibres, occasions the furrows just now mentioned. Below these we observe, near the semicircular edges, a great many risings and depressions, which are joined to like inequalities on the inside of the temporal bone, and form the squamous suture. Near the upper edges of these bones, towards the hind part, is a small hole in each, through which a vein passes from the teguments of the head to the longitudinal sinus.†

On the *inner concave surface* of the parietal bones we see a great many deep furrows, disposed somewhat like the branches of trees: the furrows are largest and deepest at the lower edge of each os parietale, especially near its anterior angle, where a complete canal is sometimes formed.

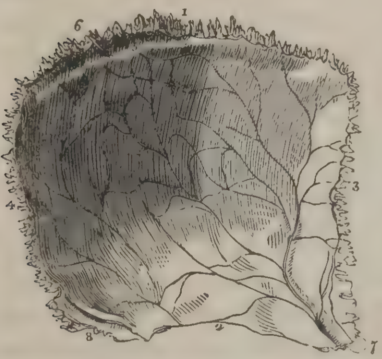
[These furrows are made by the ramifications of the great middle artery of the dura mater: they have been commonly attributed to the pulsation of the artery causing the absorption of the bone, but it is more probable that the deposition of the bone has been prevented where the artery beats, and thus the bone becomes modelled over the artery in the same way that it is made to conform to the surface of the brain. If it

* The external surface of the left parietal bone. 1. Superior or sagittal border. 2. Inferior or squamous border. 3. Anterior or coronal border. 4. Posterior or lambdoidal border. 5. The temporal ridge. The figure is situated immediately over the parietal protuberance. 6. The parietal foramen, unusually large. 7. The anterior inferior angle. 8. The posterior inferior angle.

† It transmits, also, an artery from the integuments to the dura mater, and is called the parietal foramen.—P.

were exclusively an absorption and not a deposition, we should scarcely find the artery occasionally surrounded perfectly by bone.]

Fig. 13.*



On the inside of the upper edge of the ossa parietalia there is a large sinuosity, frequently larger in the bone of one side than of the other, where the upper part of the falx is fastened, and the superior longitudinal sinus is lodged. Part of the lateral sinuses generally makes a depression near the angle formed by the lower and posterior edges of these bones; and the pits made by the convolutions of the brain are in no part of the skull more frequent or more conspicuous, than in the internal surface of these bones.

The ossa parietalia are the most equal and smooth, and are among the thinnest bones of the cranium; but they enjoy the general structure of two tables and diploe most perfectly.

These bones are joined at their foreside to the os frontis, at their long inferior angles, to the sphenoid bone; at their lower edge, to the ossa temporum; behind to the os occipitis, or ossa triquetra; and above, to one another.

Ossa Temporum.†

The *ossa temporum* are situated at the lateral and inferior

* The internal surface of the left parietal bone. 1. The superior, or sagittal border. 2. The inferior, or squamous border. 3. The anterior, or coronal border. 4. The posterior, or lambdoidal border. 5. Part of the groove for the superior longitudinal sinus. 6. The internal termination of the parietal foramen. 7. The anterior inferior angle of the bone, on which is seen the groove for the trunk of the arteria meningea media. 8. The posterior inferior angle, upon which is seen a portion of the groove for the lateral sinus.

† This bone has received the name of temporal, because at the region which it covers, the hair usually commences to turn gray, and thus in some measure indicates the different periods of life.—P.

parts of the cranium; each of them is divided into three portions, a superior or squamous, a posterior or mastoid, and a middle or petrous.

The *squamous portion* is nearly semicircular in form, and very thin; its edge is sharp, and the inner table appears pared away to form the squamous suture with the corresponding edge of the parietal bone. Its external surface is covered by the temporal muscle. At the lower and anterior part of this surface, the zygomatic process arises, it proceeds forward to join the cheek bone, and form an arch under which the temporal muscle passes.

At the base of the process is the glenoid cavity for the condyle of the lower jaw. Immediately before this cavity is a tubercle or protuberance, near the commencement of the zygoma and at its lower border, to which the external lateral ligament of the lower jaw is attached; continued horizontally inwards from the tubercle there is a rounded eminence, called the *eminentia articularis*, which forms part of the articular surface on which the condyle rises when the jaw is opened. In the posterior part of the cavity is a fissure—called the *glenoid*—in which part of the ligament of this articulation is fixed. In this fissure is an aperture—*glenoid foramen*—which communicates with the cavity of the tympanum of the ear, and is occupied by a small nerve called *chorda tympani*; and also by the anterior muscle of the malleus—one of the small bones of the ear.

The internal surface of the squamous portion is concave; it is marked by pits and small eminences, which correspond with the convoluted surface of the brain, and also by impressions of the arteries of the dura mater, see 4 fig. 13, as they go towards the parietal bone.

The *mastoid* or *occipital portion* is the smallest of the three parts of the bone; it consists of an angular portion, which occupies a vacuity between the occipital and parietal bones; and of the mastoid process. The mastoid process has some resemblance to the nipple; it is composed internally of cells which communicate with the cavity of the tympanum. On

the internal side of its base is a deep groove in which the posterior belly of the digastric muscle is inserted. Behind this process is the mastoid hole, which transmits a vein, and sometimes a small artery.

On the internal surface of this portion is a large groove, which is formed by the lateral sinus. The mastoid hole above mentioned, opens into this groove.

Fig. 14.*

The *petrous portion*, which is situated between the squamous and mastoid, resembles a triangular pyramid lying on one of its sides. When in its proper position it projects inward and forward. The two upper sides form a portion of the internal surface of the base of the cranium. The angle formed by these surfaces is very prominent, and divides the fossa for the middle lobes of the brain, or rather the cavities for the cerebrum from those which contain the cerebellum.

One of these *sides* of the petrous portion looks forward and outward, the other backward and inward. Each of them has eminences and depressions to correspond with the convolutions of the brain. Near the middle of the *anterior side* is a small furrow, leading to a foramen denominated *Innominatum* or *Hiatus Fallopii*, which transmits the vidian nerve to the aqueduct of Fallopius.

* The external surface of the temporal bone of the left side. 1. The squamous portion. 2. The mastoid portion. 3. The extremity of the petrous portion. 4. The zygoma. 5. Indicates the tubercle of the zygoma, and at the same time its anterior root turning inwards to form the eminentia articularis. 6. The superior root of the zygoma, forming the posterior part of the temporal ridge. 7. The middle root of the zygoma terminating abruptly at the glenoid fissure. 8. The mastoid foramen. 9. The meatus auditorius externus, surrounded by the processus auditorius. 10. The digastric fossa, situated immediately to the inner side of (2) the mastoid process. 11. The styloid process. 12. The vaginal process. 13. The glenoid or Glaserian fissure; the leading line from this number crosses the rough posterior portion of the glenoid fossa. 14. The opening and part of the groove for the Eustachian tube.

—There is another small oblique foramen immediately beneath this, which transmits the *nervous petrosus superficialis minor*, a branch of Jacobson's nerve; near the apex of the petrous portion of the temporal bone there is seen a large foramen, the termination of the carotid canal. On this anterior face of the bone, especially in the young subject, is seen a rising or eminence running from base to apex, which is formed by the projection of the perpendicular semicircular canal.

About the middle of the *posterior side* is the large aperture called *meatus auditorius internus.* The bottom of this cavity is perforated by several foramina: the largest and uppermost of which is the orifice of a winding canal, called improperly the *aqueduct* of Fallopius, which transmits the portio dura of the seventh pair of nerves. The other foramina transmit the fibres of the portio mollis of the same nerve. Posterior to the orifice of the meatus internus is an oblong depression, with a foramen in it, covered by a shell of bone, which is the orifice of a proper aqueduct or canal that passes from the vestibule of the ear.*

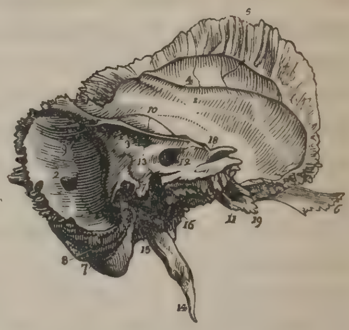
—Neither of the so called aqueducts of the vestibule or cochlea, are deserving of the name which has nevertheless been continued to designate them, since we no longer believe with Cotugnius their discoverer, that they are a sort of passages, to admit of the overflow of the lymph, when it was secreted in superabundance in the labyrynth. They are both mere openings, for the transmission mainly of blood vessels. The aqueduct of the vestibule transmits a small artery and vein to the vestibule, and lodges a process of the dura mater.—

The *inferior side* of the *petrous portion* forms a part of the external surface of the basis of the cranium. On the back part of it is the external orifice of the canal, through which the portio dura passes. It is called *foramen stylo mastoideum.* Before this foramen is a long and slender styloid process, which varies from one to two inches in length; it projects

* This orifice should not be confounded with one which is nearer to the meatus internus, and situated on the angle made by the two sides of the bone.—H.

almost perpendicularly from the basis of the cranium, and gives origin to a muscle of the tongue, of the os hyoides, and of the pharynx, and also to several ligaments. The base of this process is surrounded by a flat projection of bone, occasionally called the vaginal process.

Fig. 15.*



On the inside of this process, and rather before it, is the jugular fossa, which, when applied to a corresponding part of the occipital bone, makes the posterior foramen lacerum, through which the internal jugular vein, and the eighth pair of nerves pass out. A small spine called the jugular process often projects into this foramen from the temporal bone, and separates the nerve from the vein; the nerve being anterior. —Upon a ridge which is found at the root of this spine, and just behind the margin of the carotid foramen, there is a small opening leading into the canal which transmits Jacobson's *tympanic branch* of the glosso-pharyngeal nerve, which forms

* The left temporal bone, seen from within. 1. The squamous portion. 2. The mastoid portion. The number is placed immediately above the inner opening of the mastoid foramen. 3. The petrous portion. 4. The groove for the posterior branch of the arteria meningea media. 5. The bevelled edge of the squamous border of the bone. 6. The zygoma. 7. The digastric fossa immediately internal to the mastoid process. 8. The occipital groove. 9. The groove for the lateral sinus. 10. The elevation upon the anterior surface of the petrous bone marking the situation of the perpendicular semicircular canal. 11. The opening or termination of the carotid canal. 12. The meatus auditorius internus. 13. A dotted line leads upwards from this number to the narrow fissure which lodges a process of the dura mater. Another line leads downwards to the sharp edge which conceals the opening of the aquæductus cochleæ, while the number itself is situated on the bony lamina which overlies the opening of the aquæductus vestibuli. 14. The styloid process. 15. The stylo-mastoid foramen. 16. The carotid foramen. 17. The jugular process. The deep excavation to the left of this process forms part of the jugular fossa, and that to the right is the groove for the vein of the cochlea. 18. The notch for the fifth nerve upon the upper border of the petrous bone, near to its apex. 19. The extremity of the petrous bone which gives origin to the levator palati and tensor tympani muscles.

an important part of the nervous plexus of the tympanum.—Before this spine, or partition, is the orifice of the second aqueduct of the ear, the aqueduct of the cochlea, through which passes a vein from the cochlea to the internal jugular, and in which is lodged a process of the dura mater. This jugular fossa is at the termination of the groove, in the internal surface of the bone, made by the lateral sinus. At a small distance before the jugular fossa is the commencement of the carotid canal, which makes a curve almost semicircular, and then proceeds in a horizontal course to the anterior extremity of the bone: through this winding canal passes the carotid artery, and the filaments from the fifth and sixth pair of nerves, which are the beginning of the intercostal or sympathetic nerve.

Between the carotid canal and the cavity for the condyle of the lower jaw, at the junction of the anteror part of the squamous portion with the petrous portion of this bone, is a very rough aperture, the bony margin of which appears broken; this is the orifice of the bony part of the *Eustachian* tube, or passage from the throat to the ear. This canal is divided lengthwise by a thin bony plate; the upper passage contains the internal muscle of the malleus bone of the ear *(tensor tympani);* the lower and largest canal is the bony part of the Eustachian tube.

The external passage to the ear, called *Meatus Auditorius Externus,* is situated between the zygomatic and the mastoid processes. The orifice is large and smooth above, but rough below, and is surrounded by a rough lip called the auditory process. The direction of the canal is obliquely inward and forward.

—*Angles of the bone.* The *superior* angle of the bone which separates the *anterior* and *posterior* faces, is sharp and gives attachment to the tentorium cerebelli. It is slightly grooved for the lodgement of the superior petrous sinus, and near its extremity is marked by a smooth notch, upon which rests the fifth or trigeminus nerve. The *anterior* angle which separates the *anterior* from the *inferior* or basilar surface of the bone, is grooved for the Eustachian tube, and forms the posterior

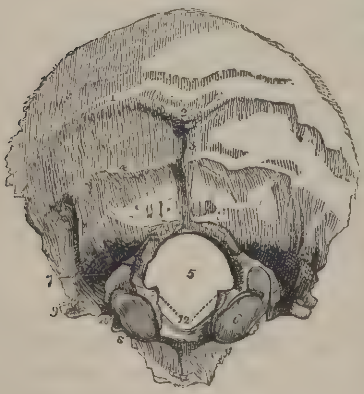
boundary of the foramen lacerum anterius of the base of the cranium. The *posterior* angle separating the posterior from the basilar surface of the bone, is grooved for the inferior petrous sinus and excavated for the jugular fossa: it forms the anterior boundary of the foramen lacerum posterius.—

The *temporal* is articulated with the *parietal, occipital* and *sphenoidal* bones, and by its *zygomatic* process with the *malar* bone.

Os Occipitis.

The *occipital bone* is situated at the posterior and inferior part of the cranium; it is of a rhomboidal figure, with convex and concave surfaces.

Fig. 16.*



The upper part of the external surface is smooth: at a small distance above the middle of the bone is the external occipital protuberance, with a curved line on each side of it. Near the middle of the bone the trapezii muscles are attached to this line, and externally, on each side, the occipito frontalis, and the sterno mastoideus. Under this line is a depression, on each side, into which are inserted the complexus and the splenius capitis muscles.

Below this is the inferior curved line, and still lower is a

* The external surface of the occipital bone. 1. The superior curved line. 2. The external occipital protuberance. 3. The spine or vertical ridge. 4. The inferior curved line. 5. The foramen magnum. 6. The condyls of the right side. 7. The posterior condyloid fossa, in which the posterior condyloid foramen is found. 8. The anterior condyloid foramen, concealed by the margin of the condyle. 9. The jugular eminence or transverse process as it is sometimes called. 10. The notch in front of the jugular eminence, which forms part of the jugular foramen. 11. The basilar process. 12. The rough projections into which the moderator ligaments are inserted.

muscular depression to which the rectus minor posticus is attached on each side near the middle; and the rectus major posticus, and obliquus superior, near the end.

Below the protuberance is a spine which passes down the middle of the bone, and at the lower extremity of this spine is the great occipital foramen, which forms the communication between the cavities of the cranium, and the vertebral column. This great opening transmits the medulla spinalis with its membranes, the accessary nerves of Willis, and the vertebral arteries and veins.

It is rather of an oval form, and the occipital condyles are situated anteriorly on its edges. These condyles are of an irregular oval figure; they are not parallel, but incline towards each other anteriorly. Their articulating surfaces are oblique, looking downward and outward; they are received into corresponding cavities of the atlas, or first cervical vertebra, and form with them the articulation of the head and neck. From the oblique position of their articulating surfaces, as well as the length of their ligaments and the inclination of their axes towards each other, it results, that their motion is confined to flexion and extension. On the internal sides of these condyles is a rough surface, to which are attached the strong ligaments that come from the processus dentatus of the second vertebra of the neck.

Behind each condyle is a depression in which is situated the posterior condyloid foramen, for transmitting the cervical veins; and at their anterior extremities are two large foramina, (anterior condyloid,) through which pass the ninth pair of nerves.

On the internal surface of the os occipitis is the crucial ridge, to which are attached the *falx cerebelli* or *vertical*, and the *tentorium* or *horizontal* process of the dura mater.

The groove made by the longitudinal sinus continues from the sagittal suture along the upper limb of this cross. Sometimes it is on the side of the ridge, and sometimes the ridge is depressed, and it occupies its place; at the centre of the cross, where is lodged the torcular Herophili, formed by the

common junction of the sinuses, the groove for the longitudinal sinus divides into two grooves for the lateral sinuses;

Fig. 17.*

these form the horizontal limbs of the cross, and proceed towards the foramen lacerum where the lateral sinuses emerge from the cavity of the cranium. The lower limb of the cross is formed by a spine which proceeds from the centre of the bone to the great occipital foramen, and supports the falx of the cerebellum. The internal surface of the bone is divided by the cross into four portions, each of which is considerably depressed so as to form fossæ; the two upper by the posterior lobes of the cerebrum, and the lower by those of the cerebellum.

This circumstance occasions great inequality in the thickness of the bone, as the depressed portions are extremely thin, while the ridge adds greatly to the thickness, especially at the centre of the cross, which is opposite to the great external protuberance.

Before the great occipital foramen is the cuneiform process, which is thick and substantial; it terminates by a broad truncated extremity, that is articulated with the body of the sphenoid bone. The internal surface of the cuneiform process

* The internal surface of the occipital bone. 1. The left cerebral fossa. 2. The left cerebellar fossa. 3. The groove for the posterior part of the superior longitudinal sinus. 4. The spine for the falx cerebelli, and groove for the occipital sinuses. 5. The groove for the left lateral sinus. 6. The internal occipital protuberance which lodges the torcular Herophili. 7. The foramen magnum. 8. The basilar process, grooved for the medulla oblongata. 9. The termination of the groove for the lateral sinus, bounded externally by the jugular eminence. 10. The jugular fossa; this fossa is completed by the petrous portion of the temporal bone. 11. The superior border. 12. The inferior border. 13. The border which articulates with the petrous portion of the temporal bone. 14. The anterior condyloid foramen.

is somewhat excavated, and forms a large superficial groove for the medula oblongata; on each side of this groove is a small furrow for the inferior petrous sinuses.

The two upper edges of the occipital bone are serrated, to articulate, with those of the parietal, and form the lambdoidal suture. The inferior edges are divided into two portions by a small prominence called the *jugular eminence;* the upper and posterior portion is also serrated for articulation with the mastoid portion of the temporal; the inferior portion, which is not serrated, applies to the petrous portion of the temporal bone, and a notch in it contributes to the formation of the foramen lacerum.

The upper angle of this bone is acute, the lateral angles are obtuse, and the inferior truncated. It is articulated with the parietal, the temporal, and the sphenoidal bones.

Os Ethmoides.

The *os ethmoides* is truly one of the most curious bones of the human body. It appears almost a cube, not of solid bone, but exceedingly light and spongy, and consisting of many convoluted plates, which form a network like honey-comb. It is firmly enclosed in the os frontis, betwixt the orbitary processes of that bone. One horizontal plate receives the olfactory nerves, which perforate that plate with such a number of small holes, that it resembles a sieve; whence the bone is named cribriform, or ethmoid. Other plates are so arranged that they form a cellular structure, on which the olfactory nerves are expanded by means of a particular membrane; while an additional plate, appropriated to the nose, descends into that cavity in a perpendicular direction, and forms a large proportion of the partition which divides it into two chambers.

The cribriform plate is situated in the anterior part of the basis of the cranium. The cellular part occupies most of the space between the orbits of the eyes, and the perpendicular plate is to be found in the septum of the nose.

The ethmoid bone, for the purposes of description, may be divided into three parts, viz. the *cribriform plate*, the *nasal* or *perpendicular lamella*, and the *cellular portions*.

The *cribriform plate* is oblong in shape, and firm in its structure; in the middle of the anterior extremity the crista galli projects from its upper surface, dividing it into two lateral portions, each of which is rather concave, and occupied by the bulbous extremity of the olfactory nerve; it is perforated by many foramina, which transmit the fibres of the aforesaid nerve. Near the crista galli, on each side, there is a small fissure, through which passes a nervous filament derived from the ophthalmic branch of the fifth pair. The crista galli varies in size in different subjects: the beginning of the falciform process of the dura mater is attached to it, and with the opposite part of the os frontis it forms the foramen cæcum, already mentioned. It is very conspicuous in the basis of the cranium.

The *nasal plate* of the ethmoid bone seems to be continued downwards from the crista galli through the cribriform plate. It is thin, but firm; it forms the upper portion of the septum of the nose, and, to complete the partition, it unites with the vomer and with a plate of cartilage before. It is very often inclined to one side, so that the nostrils are not of equal size.

At a small distance from this perpendicular plate, on each side of it, the *cellular portions* originate from the lower surface of the *cribriform plate;* they extend from before backward, and are as long as the ethmoid bone; their breadth between the eye and the cavity of the nose varies in different subjects, from half an inch to more; they extend downwards from the root of the nose or from the cribriform plate, more than half way to the roof of the mouth. Their external surface on each side forms a part of the surface of the orbit of the eye, and is called *os planum;* their internal surface forms part of the external lateral surface of each nostril. This surface extends the whole depth of the nostril, from before backward; but in many skeletons it is extremely imperfect, owing to the great brittleness of the bony plates of which it is composed. When the bone is perfect, the uppermost half part of this internal surface is uniformly flat, and rather rough; but below it, about the middle of the bone, a deep groove begins, which extends downwards and backwards, to the posterior extremity; this is

the *upper channel* or *meatus* of the nose. The edge of the surface immediately above it projects in a small degree over this channel or groove; having been described by Morgagni, it bears his name, and may be considered as one of the spongy or turbinated bones; from its situation, it should be called the first or superior. The groove is very deep, and most of the cells of the *posterior part of the ethmoid bone communicate with it, through one or more foramina at its anterior extremity.*

The part of the surface of the ethmoid which is immediately below this groove, is convex; that which is before and below it, is rather flat; the convex part is *the middle spongy or turbinated bone*, as it has commonly been called; it projects obliquely into the cavity of the nose, and hangs over the middle channel or meatus, which is immediately below the ethmoid bone. The internal surface of this spongy bone, which is opposite the septum of the nose, is convex and rough or spongy; the external surface is concave. The *anterior cells* of the ethmoid, and particularly those which the *frontal sinuses* on each side communicate with, open into the middle channel or meatus, under the anterior end of this turbinated bone.

This *middle channel* or *meatus*, is much larger than that above; it extends from the anterior to the posterior part of the nostrils, and slopes downwards and backwards. The cavity of the upper maxillary bone, or the antrum highmorianum, opens on each side into this meatus, and a thin plate of bone extends from the cellular part of the ethmoid so as to cover a part of it.

The *cellular portions of the ethmoid* are composed of plates thinner than the shell of an egg; they are entirely hollow, and the cells are very various, in number, size, and shape. Some cells of the uppermost row communicate with those of the os frontis, formed by the separation of the plates of the orbitar process of that bone.

From the posterior part of the cribriform plate, where it is in contact with the lesser wings of the sphenoidal bone, thin plates of bone pass down upon the anterior surface of the body of the os sphenoides, one on each side of the azygos process, and often diminish the opening into the sphenoidal cells.

These plates are sometimes triangular in form, the basis uniting with the cribriform plate. They have been described very differently by different authors, some considering them as belonging to the os ethmoides, and others to the sphenoid bone. To the perfect ethmoid bone there are attached two triangular pyramids, in place of the triangular bones; these pyramids are hollow, the azygos process of the os sphenoides is received between them; one side of each pyramid applies to each side of the azygos process, another side applies to the anterior surface of the body of the sphenoid bone, in place of the ossa triangularia, and the third side is the upper part of one of the posterior nares.* There are two apertures in each of these

* This may be considered as an original observation of the lamented Wistar. The merit of it has been denied to him, more particularly by the anatomists of Paris, under an impression that he had been anticipated in it by Bertin, who has written an excellent and minute treatise on osteology. The extent to which the claims of other anatomists interfere with his, he was fully aware of; and it will be seen by the following communications to the American Philosophical Society, that these are placed in as important a light as they deserve, at the same time that he vindicates his own pretensions, to have first observed the "cornets sphenoidaux" in the form of triangular hollow pyramids, as constituting part of the perfect ethmoid bone.—H.

Observations on those Processes of the Ethmoid Bone which originally form the Sphenoid Sinuses. By C. Wistar, M. D., President of the Society, Professor of Anatomy in the University of Pennsylvania.—Read, Nov. 4, 1814.

" It has been long believed that the sinuses, or cavities in the body of the os sphenoides, were exclusively formed by that bone, when Winslow suggested that a small portion of the orbitar processes of the ossa palati contributed to their formation.*

Many years after Winslow's publication, Monsieur Bertin described two bones which form the anterior sides of these sinuses, and contain the foramina by which they communicate with the nose.†

These bones he denominates "Cornets Sphenoidaux," and states that they are most perfect and distinct between the ages of four years and twenty; that they are not completely formed before this period, and that after it they appear like a part of the sphenoidal bone.—According to his account they are lamina of a triangular form, and are originally in contact with the anterior and inferior surface of the body of the os sphenoides, so that they form a portion of the surface of the cavity of the nose.—He believed, that as they increase in size, they become convex and concave, and present their concave surfaces to the body of the sphenoidal bone, which also becomes concave, and presents its concavity to those bones; thus forming the sinuses.

* In his description of the Ossa Palati, printed in the Memoirs of the Academy of Sciences for 1720.

† See Memoirs of the Academy of Sciences for 1774.

pyramids; one at the base opening directly into the nose, near the situation of the opening of the sphenoidal sinuses, in the bones of adults; and the other in each of the sides in contact with the azygos process.

Os Sphenoides.

The *os sphenoides* or *pterygoideus,* resembles a bat with its wings extended. It consists,

This account of M. Bertin has been adopted by Sabatier, and also by Boyer, who has improved it by the additional observation, that these triangular bones are sometimes united to the ethmoid, and remain attached to that bone when it is separated from the os sphenoides. Bichat and Fyfe have confirmed the description of Boyer.

The specimens of ethmoid and sphenoid bones, herewith exhibited to the society, will demonstrate that in certain subjects, about two years of age, there are continued from the posterior part of the cribriform plate of the ethmoid, *two Hollow Triangular Pyramids*, which, when in their proper situations, receive between them the azygos process of the os sphenoides.—(See Plate X. Figures 1, 2, 3, with the explanation.)

The internal side of each of these pyramids applies to the aforesaid azygos process; the lower side of each forms part of the upper surface of the posterior nares; the external side at its basis is in contact with the orbitar process of the os palati. The base of each pyramid forms also a part of the surface of the posterior nares, and contains a foramen which is ultimately the opening into the sphenoidal sinus of that side.

In the sphenoidal bones, which belong to such ethmoids as are above described, there are no cells or sinuses; for the pyramid of the ethmoid bones occupy their places. The azygos process, which is to become the future septum between the sinuses, is remarkably thick, but there are no cavities or sinuses in it.

The sides of the pyramids, which are in contact with this process, are extremely thin, and sometimes have irregular foramina in them, as if their osseous substance had been partially absorbed.* That part of the external side of the pyramid which is in contact with the orbitar process of the os palati is also thin, and sometimes has an irregular foramen, which communicates with the cells of the aforesaid orbitar process.

Upon comparing these perfect specimens of the ethmoid and sphenoidal bones of the subject about two years of age, with the os sphenoides of a young subject who was more advanced in years, it appears probable that the azygos process and the sides of the pyramid applied to it, are so changed, in their progress of life, that they simply constitute the septum between the sinuses; that the external side of the pyramid is also done away, and that the front side and the basis of the pyramid only remain; constituting the Cornets Sphenoidaux† of M. Bertin.

If this be really the case, the origin of the sphenoidal sinuses is very intelligible.

* See *e*, Fig. 3.

† "Cornet" is the word applied by several French anatomists to the Ossa Turbinati of the nose; they seem to have intended to express by it a convoluted lamina or plate of bone.

The fine drawing of the Ethmoid Bone, for this plate was done by my friend M. Lesueur, whose talents are so conspicuous in the plates attached to Peron's "Voyage de Déscouvertes aux Terres Australes."

1st. Of a *body* with two processes arising from it, called the *lesser wings*, or apophyses of Ingrassias.

2dly. Of two large lateral processes, called the *greater wings*, or temporal processes; and,

3dly. Of two vertical portions, denominated *pterygoid processes.*

The *body* is situated near the centre of the cranium, and in contact with the cuneiform process of the occipital bone; the *greater wings* extend laterally between the frontal and temporal bones as high as the parietal; while *the pterygoid* processes pass downwards on each side of the posterior opening of the nose, as low as the roof of the mouth. It is, therefore, in contact with all the other bones of the cranium, and with many bones of the face.

The *body* has a cubic figure; its *upper* surface forms a portion of the basis of the cranium; its *lower* and *anterior surfaces* form part of the cavity of the nose; the *posterior surface* is articulated with the cuneiform process of the occipital bone; and

Explanation of the Figures in the Plate referred to above.

FIG. I.

Represents the upper surface, or cribriform plate of the Ethmoid Bone.

a. Crista Galli.

b b b b. Cribriform plate.

c. Surface denominated Os Planum.

d d. Hollow Triangular Pyramids.

e. Space between the Pyramids for receiving the Azygos Process of the Os Sphenoides.

FIG. II.

A lateral View of the Bone.

a. Crista Galli.

c. Os Planum.

d. Triangular Pyramid.

FIG. III.

The Bone Inverted.

a. The Nasal Plate of the Ethmoid Bone, which constitutes the upper portion of the Septum of the nose.

g g. Those portions of the Ethmoid which are called Superior Turbinated Bones.

f f. The Cellular Lateral Portions of the Bone.

d d. The Triangular Pyramids.

e. Space between the Pyramids for the Azygos Process of the Os Sphenoides—a foramen on the internal side of one of the Pyramids.

Fig. 1.

Fig. 2.

Fig. 3.

laterally it is extended into the great wings, or temporal processes.

On the upper surface of the body, the lesser wings or the apophyses of Ingrassias,* project from the lateral and anterior parts; these wings consist of two triangular plates, each of which is joined to the other by its base, and to the body of the os sphenoides by its under surface near the base, and terminates in a point; their direction is forwards and outwards, and their flat surfaces are horizontal. Anteriorly they are connected by suture to the ethmoid and frontal bones; their posterior edge is rounded, and detached from any other bone, forming the upper margin of the foramen lacerum of the orbit of the eye; this edge is thick and prominent at its internal extremity, and these prominences are called the *anterior* or *clinoid processes;* immediately before them are the *optic foramina,* which pass

Fig. 18.†

* A physician of Palermo, who died in 1580, aged 70.—H.

† The superior or cerebral surface of the sphenoid bone. 1. The processus olivaris. 2. The ethmoidal spine. 3. The lesser wing of the left side. 4. The cerebral surface of the greater wing of the same side. 5. The spinous process. 6. The extremity of the pterygoid process of the same side, projecting downwards from the under surface of the body of the bone. 7. The foramen opticum. 8. The anterior clinoid process. 9. The groove by the side of the Sella Turcica, for lodging the internal carotid artery, cavernous plexus, cavernous sinus, and orbital nerves. 10. The Sella Turcica. 11. The posterior boundary of the Sella Turcica; its projecting angles are the posterior clinoid processes. 12. The basilar portion of the bone. 13. Part of the sphenoidal fissure. 14. The foramen rotundum. 15. The foramen ovale. 16. The foramen spinosum. 17. The angular interval which receives the apex of the petrous portion of the temporal bone. The posterior extremity of the Vidian canal terminates at this angle. 18. The spine of the spinous process; it affords attachment to the internal lateral ligament of the lower jaw. 19. The border of the greater wing and spinous process which articulates with the anterior part of the squamous portion of the temporal bone. 20. The internal border of the spinous process, which assists in the formation of the foramen lacerum basis cranii. 21. That portion of the greater ala which articulates with the anterior inferior angle of the parietal bone. 22. The portion of the greater ala which articulates with the orbital process of the frontal bone.

obliquely through the wings into the orbit of the eye, and transmit on each side the optic nerve and a small artery.

Behind the *optic foramen* is a notch and sometimes a foramen, made by the carotid artery. When the notch is converted into a foramen, it is by a small bony pillar being extended from the anterior clinoid process, to the body of the sphenoid. A groove made by the optic nerves, is often seen extending across the body of the bone, from one of the optic foramina to the other. Behind it is a depression, which occupies the greatest part of this surface of the bone, in which the pituitary gland is lodged; the back part of this depression is bounded by a transverse eminence, called the posterior clinoid process. These three processes are called *clinoid* from their supposed resemblance to the supporters of a bed; and the depression for the pituitary gland is called *sella turcica* from its resemblance to the saddle used by the Turks.

On each side of the posterior clinoid process is a groove in the body of the bone, made by the carotid artery as it passes from the *foramen caroticum* of the temporal bone. The *posterior surface* of the body of the sphenoides is rough, for articulation with the truncated end of the cuneiform process of the os occipitis.

On the *anterior* and *inferior surfaces* is a spine, called the azygos process, or rostrum which is received into the base of the vomer, and extends forward until it meets the nasal plate of the ethmoid bone; on each side of this spine, in the *anterior surface*, are the orifices of the *sphenoidal cells.* Those orifices appear very differently in different bones; in some very perfect specimens, they are irregularly oval, being closed below and on their external sides, by the processes of the ossa palati, and above by the triangular plates, as they have been called, of the ethmoid bone. The cells or sinuses, to which these orifices lead, occupy the body of the sphenoidal bone; they are divided by a partition, and each of them has a communication with the cavity of the nose on its respective side, by the orifice above described. The sinuses do not exist during infancy; they increase in the progress of life, and are very large in old age.

Laterally, the body of the sphenoides is extended into the portions called the *great wings* or *temporal processes.* These *great wings* compose the largest part of the bone, and their internal surface forms a portion of the middle fossa of the base of the cranium. Externally, the surface of each great wing is divided into two portions: one of which is lateral, and unites to the frontal, temporal, and malar bones, forming part of the smooth surface for the temporal muscle; the other portion forms part of the orbit of the eye, and is very regular and smooth. As the ethmoid bone forms part of the inside, this portion of the great wing forms part of the outside of the orbit, and is termed the *orbitary process* of the sphenoid bone. The horizontal part of each wing terminates in an acute angle termed *spinous process*, which penetrates between the petrous portion and the articulating cavity of the temporal bone. In this angle is the foramen for the principal artery of the dura mater; near the point of the angle is a small process, which projects from the basis of the cranium, and is called *styloid.*

Fig. 19.*

The *pterygoid processes* pass downwards in a direction almost perpendicular to the base of the skull. Each of them has two plates, and a middle fossa facing backwards; to complete the comparison, they should be likened to the legs of the bat, but are inaccurately named pterygoid, or wing-like processes. The external plates are broadest, and the internal are longest. From each side of

* The antero-inferior view of the sphenoid bone. 1. The ethmoid spine. 2. The rostrum. 3. The sphenoidal spongy bone, partly closing the left opening of the sphenoidal cells. 4. The lesser wing. 5. The foramen opticum piercing the base of the lesser wing. 6. The sphenoidal fissure. 7. The foramen rotundum. 8. The orbital surface of the greater wing. 9. Its temporal surface. 10. The pterygoid ridge. 11. The pterygo-palatine canal. 12. The foramen of entrance to the Vidian canal. 13. The internal pterygoid plate. 14. The hamular process. 15. The external pterygoid plate. 16. The foramen spinosum. 17. The foramen ovale. 18. The extremity of the spinous process of the sphenoid.

the external plates the pterygoid muscles take their rise. At the root of each internal plate, a small hollow may be remarked, where the musculus circumflexus palati rises, and part of the cartilaginous end of the Eustachian tube rests. At the lower end of the plate is a hook-like process (*hamulus*) round which the tendon of the last named muscle plays, as on a pulley. The ossa palati, on each side, rest upon these internal plates; and, therefore, the pterygoid processes seem to support the whole face.

Foramina of the Sphenoidal Bone.

Before these foramina are described, it is necessary to state, that the nerves of the brain are named numerically, beginning with the olfactory, which is foremost.

It should also be observed, that each nerve of the fifth pair is divided, before it passes from the cavity of the cranium, into three large branches.

The first foramina are the *optic*, which have been already described; they transmit the optic, or second pair of nerves, and a small artery, to the ball of the eye.

The second foramen, on each side, is the *foramen lacerum.* It commences largely at the sella turcica, and extends laterally a considerable distance, until it is a mere fissure. The upper margin of this foramen is formed by the anterior clinoid processes, and the edges of the smaller wings of the sphenoid bone. This foramen transmits the third, fourth, and sixth pair of nerves, and the first branch of the fifth pair, to the muscles, and the other parts, subservient to the eye.

The *foramen rotundum*, or third hole, is round; as its name imports. It is situated immediately under the foramen lacerum, on each side, and transmits the second branch of the fifth pair of nerves to the upper maxillary bone.

The *foramen ovale* is the fourth hole. It is larger than the foramen rotundum, and half an inch behind it. It transmits the third branch of the fifth pair of nerves to the lower jaw.

The fifth hole is the *foramen spinale.* It is small and round, and placed in the point of the spinous process, behind the foramen ovale, to transmit the principal artery of the dura mater, which makes its impression upon the parietal bone.

The sixth foramen is under the basis of each pterygoid process, and is therefore called the *pterygoid*, or the *Vidian* foramen.* It is almost hidden by the point of the petrous portion of the temporal bone, and must be examined in the separated bone. It is nearly equal in size to the spinous hole.

This foramen transmits a nerve that does not go out from the cavity of the skull, but returns into it. The second branch of the fifth pair, after passing out of the cranium, sends back, through this foramen, a branch called the *Vidian*, which upon its arrival in the cavity of the cranium, enters the temporal bone by the foramen innominatum.

Of the Face.

The *face* is the irregular pile of bones composing the front and under part of the head, and is divided into the upper and lower maxillæ, or jaws.

The *upper jaw* consists of six bones on each side, of one single bone placed in the middle, and of sixteen teeth.

The thirteen bones are, two ossa maxillaria superiora, two ossa nasi, two ossa unguis, two ossa malarum, two ossa palati, two ossa spongiosa inferiora, and the vomer.

The *ossa maxillaria superiora* form the principal part of the cavity of the nose, with the whole lower and forepart of the upper jaw, and a large proportion of the roof of the mouth.

The *ossa nasi* are placed at the upper and front part of the nose.

The *ossa unguis* are at the internal angles of the orbits of the eyes.

The *ossa palati* in the back part of the palate, extending upwards to the orbits of the eyes.

The *ossa spongiosa* in the lower part of the cavity of the nose; and

The *vomer* in the partition which separates the two nostrils.

* From its reputed discoverer, Vidius, a professor at Paris.

Ossa Maxillaria Superiora.

The *ossa maxillaria superiora*, or *upper jaw bones*, may be considered as the basis or foundation of the face; as they form a large part of the mouth, the nose, and the orbit of the eye.

The central part of each bone, which may be considered as its body, is hollow, and capable of containing, in the adult, near half an ounce of fluid. The plate which covers this cavity is the bottom of the orbit of the eye. The sockets of the large teeth are below it. The roof of the mouth projects laterally from the inside of it. A process for supporting the cheek bone is on the outside; and another process goes up before it, which forms the side of the nose.

Fig. 20.*

In each *upper maxillary bone* the following parts are to be examined:

The *nasal process;* the *orbitar plate*; the *malar process;* the *alveolar process*; the *palatine process;* the *anterior* and *posterior surfaces;* the *great cavity;* the *internal* or *nasal surface;* and the *three foramina.*

The *nasal process*, which extends upwards to form the side of the nose, is rather convex outwards, to give the nostril shape. Its sides above support the nasal bone; and a cartilage of the alæ nasi is fixed to its edge below.

The margin of the orbit of the eye is marked by a sharp ridge on the external surface of this process; and the part

* The superior maxillary bone of the right side, as seen from the lateral aspect. 1. The external, or facial surface; the depression in which the figure is placed is the canine fossa. 2. The posterior, or zygomatic surface. 3. The superior, or orbital plate or surface. 4. The infra-orbital foramen: it is situated immediately below the number. 5. The infra-orbital canal, leading to the infra-orbital foramen. 6. The inferior border of the orbit. 7. The malar process. 8. The nasal process. 9. The concavity forming the lateral boundary of the anterior nares. 10. The nasal spine. 11. The incisive, or myrtiform fossa. 12. The alveolar process. 13. The internal border of the orbital surface, which articulates with the ethmoid and palate bones. 14. The concavity which articulates with the lachrymal bone, and forms the commencement of the nasal duct. 15. The palate process. *i.* The two incisor teeth. *c.* The canine. *b.* The two bicuspidati. *m.* The three molares.

posterior to this ridge is concave to accommodate the lachrymal sac.

The *orbitar plate*, which covers the great cavity, and forms the bottom of the orbit, is rather triangular in form, and concave. In the posterior part is a groove or canal, which penetrates the substance of the bone, as it advances forward, and terminates in the infra-orbitary foramen, below the orbit. At the place where this plate joins the nasal process above mentioned, viz. at the inner angle of the orbit, is the commencement of the bony canal, which transmits the lachrymal duct into the cavity of the nose.

The *malar process* projects from the external and anterior corner of the orbitar plate; it supports the malar bone, and is rough for the purpose of articulating with it.

The *alveolar processes* compose the inferior and external margins of the upper maxillary bones. When these bones are applied to each other, they form more than a semicircle: their cavities contain the roots of the teeth, and correspond with them in size and form. They do not exist long before the formation of the teeth commences; they grow with the teeth; and when these bodies are removed, the alveoli disappear.

The *palate process* is a plate of bone, which divides the nose from the mouth, constituting the roof of the palate, and the floor or bottom of the nostrils. It is thick where it first comes off from the alveolar process; it is thin in its middle; and it is again thick where it meets its fellow of the opposite side. At the place where the two upper jaw bones meet, the palate plate is turned upwards, so that the two bones are opposed to each other in the middle of the palate, by a broad flat surface, which cannot be seen but by separating the bones. This surface is so very rough, that the middle palate suture almost resembles the sutures of the skull; and the maxillary bones are neither easily separated, nor easily joined again. The meeting of the palate plates by a broad surface, makes a rising, or sharp ridge, towards the nostrils; so that the breadth of the surface by which these bones meet, serves a double purpose; it joins the

bones securely, and it forms a small ridge upon which the edge of the vomer, or partition of the nose, is planted. Thus we find the palate plates of the maxillary bones conjoined, forming almost the whole of the palate; while what properly belongs to the palate bones forms a very small share of the back part only. As these thinner bones of the face have no medulla, they are nourished by their periosteum only, and are of course perforated with many small holes.

The *anterior*, *external* or *facial surface* of the upper maxillary bone is concave; the margin formed by the lower edge of the orbit, by the malar process, and by the alveolar processes, being more elevated than the central part, which consists of a depression called the *fossa canina*, which gives attachment to two muscles, the *compressor nasi*, and *levator anguli oris*. At a small distance below the orbit is the infra-orbitary foramen for transmitting a branch of the superior maxillary nerve. When these two bones are applied to each other, and the ossa nasi are in their places, they form the anterior orifice of the nasal cavity, which has a small resemblance to the inverted figure of the heart on cards.—The concave border of the opening of the nostrils, is projected forwards at its lower surface into a sharp process, forming with a similar process at the opposite side the *nasal spine*. Beneath the nasal spine, and above the two superior incisor teeth, is a slight depression called the *incisive* or *myrtiform fossa*, which gives origin to the depressor labii superioris alæque nasi muscle—.

The *posterior* or *zygomatic surface* has been called a process or tuber. The tuberosity is pierced by a number of small foramina, giving passage to the posterior dental nerves, and branches of the superior dental artery. It expands to a considerable size, and is united internally and posteriorly to the ossa palati. The *great cavity* extends from the bottom of the orbit of the eye to the roof of the mouth, and from the anterior to the posterior surface of the bone; it opens in the cavity of the nose, and is called antrum maxillare, or Highmorianum.* There is but a small portion of bone between this cavity

* After an anatomist who described it.

and the sockets of the teeth, particularly those of the second molar tooth; occasionally the fangs of the tooth enter the cavity.

The *internal* or *nasal surface* of this bone forms a large part of the cavity of the nose, and is concave. At the root of the nasal process is a ridge, for supporting the anterior end of the lower turbinated bone. The nasal process seems continued into the cavity of the nose, and forms a portion of the orifice of the canal for the lachrymal duct, which is on the external side of this cavity, near its anterior opening, and under the lower turbinated bone. The orifice in this bone by which the antrum maxillare communicates with the nose, is very large; but it is reduced to a small size, by a plate from the ethmoid bone, by a portion of the os palati, and of the lower spongy bone, each of which covers a part of it.

The three *foramina* are, 1st. The infra-orbitary foramen already described. 2d. The foramen incisivum or anterior palatine hole, which passes through the palatine process, from the nose to the mouth. In the nose it forms generally two foramina, which unite and form but one in the mouth, immediately behind the middle incisor teeth. This foramen is closed by the soft parts during life, and transmits a branch of the spheno-palatine nerve from each side, which runs on the septum narium, and joining at the lower part of the canal with its fellow, they unite, and, according to M. Cloquet,* form a ganglion. 3d. The posterior palatine foramen, which is formed by this bone, and by the os palati, on each side, is situated in the suture which joins them to each other, and transmits to the palate a branch of the upper maxillary nerve.

This bone is united to the frontal, nasal, unguiform, ethmoid and malar bones, above; to the ossa palati behind; to the corresponding bone, on the opposite side; and to the inferior spongy bone, in the cavity of the nose.

Ossa Nasi.

The *ossa nasi* are so named from their prominent situation

* This ganglion, though it varies in size, is readily found. I always exhibit it in the course of my lectures.—P.

at the root of the nose. They are each of an irregular oblong figure, being broadest at their lower end, narrowest near the middle, and larger again at the top, where the edge is rough and thick, and their connexion with the os frontis is consequently very strong. They are convex externally, and concave within. The lower edges of these bones are thin and irregular. Their anterior edges are thick, and their connection with each other, by means of their edges, is firm; the suture between them, extending down the middle of the nose, forms a prominent line on the internal surface, by which they are united to the septum narium. The uppermost half of their posterior edges is covered by the edges of the nasal processes of the upper maxillary bones; the lower half laps over the edges of these bones; and by this structure they are enabled to resist pressure. [On the posterior surface of the os nasi is a groove occupied in the recent subject by a branch of the ophthalmic nerve called the nasal, which enters the nose through the foramen orbitare internum anterius.] They are joined above to the os frontis; before, to each other; behind, to the upper maxillary bones; below, to the cartilages; and internally, to the septum of the nose.

Ossa Unguis, or Ossa Lachrymalia.

The *ossa unguis* are so named from their resemblance to a nail of the finger. They are situated on the internal side of the orbit of the eye, between the os planum of the ethmoid, and the nasal process of the upper maxillary bone. Their external surface is divided into two portions, by a middle ridge; the posterior portion forms part of the orbit; and the anterior, which is very concave, forms part of the fossa and canal, for containing the lachrymal sac and duct. This portion is perforated by many small foramina; and the whole, being extremely thin and brittle, is therefore often destroyed by the preparation of the subject.

The internal surface of this bone is generally in contact with the cells of the ethmoid; a small portion of the anterior parts is in the general cavity of the nose. Each os unguis is joined

above to the frontal bone; behind to the os planum; before and below to the maxillary bone. It sometimes is extended into the nose, as low as the upper edge of the inferior spongy bone.

Ossa Malarum.

The *ossa malarum* are the prominent square bones which form the cheek, on each side. Before, their surface is convex and smooth; backward, it is unequal and concave, for lodging part of the temporal muscles.

The four angles of each of these bones have been reckoned as processes. The one at the external canthus of the orbit called the *superior orbitar* process, is the longest and thickest. The second terminates near the middle of the lower edge of the orbit in a sharp point, and is named the *inferior orbitar* process. The third, placed near the lower part of the cheek, and thence called *maxillary*, is the shortest and nearest to a right angle. The fourth, which is called *zygomatic*, because it is extended backwards to the *zygoma* of the temporal bone, ends in a point, and, has one side straight and the other sloping. Between the two orbitar angles there is a concave arch, which makes about a third of the external circumference of the orbit, from which a fifth process is extended backwards within the orbit, to form near one-sixth of that cavity; and hence it may be called the *internal orbitar* process. From the lower edge of each of the ossa malarum, which is between the maxillary and zygomatic processes, the masseter muscle takes its origin.

On the external surface of each cheek bone, one or more small *holes* are commonly found for the transmission of small nerves or blood-vessels from, and sometimes, into the orbit. On the internal surface are the holes for the passage of the nutritious vessels of these bones. A notch, on the outside of the internal orbitar process of each of these bones, assists to form the great slit common to this bone, and to the sphenoid, maxillary, and palate bones.

The substance of these bones is, in proportion to their bulk, thick, hard, and solid, with some cancelli.

Each of the ossa malarum is *joined*, by its superior and internal orbitar processes, to the os frontis, and the orbitar process of the sphenoid bone; by the edge between the internal and inferior orbitar processes, to the maxillary bone; by the side between the maxillary and inferior orbitar process, again to the maxillary bone; and by the zygomatic process to the os temporis.

Ossa Palati.

The *ossa palati* form the back part of the roof of the mouth, and extend from it along the external sides of the posterior openings of the nose, into the orbits of the eyes. Each bone may therefore be divided into four parts, the *palate square bone*, or *palatine*, or *horizontal process*, the *pterygoid process* or *tuberosity*, the *nasal lamella* or *perpendicular plate*, and the *orbitar process.*

The *square bone* is irregularly concave, for enlarging both the mouth and cavity of the nose. The upper part of its internal edge rises in a spine, after the same manner as the palate plate of the maxillary bone does, to be joined with the vomer. Its anterior edge is unequally ragged, for its firmer connexion with the palate process of the os maxillare. The internal edge is thicker than the rest, and of an equal surface, for its conjunction with its fellow of the other side. Behind, this bone is somewhat in form of a crescent, and thick, for the firm connexion of the velum pendulum palati; the internal point being extended backwards, to afford origin to the palato-staphylinus or azygos muscle. This square bone is well distinguished from the pterygoid process by a perpendicular fossa, which, applied to a similar one in the maxillary bone, forms a passage (*pterygo-maxillary*) for the palatine branch of the fifth pair of nerves; and by another small hole behind this, through which a twig of the same nerve passes.

The *pterygoid process* is somewhat triangular, having a broad base, and ending smaller above. The back part of this process has three fossæ formed in it; the two lateral receive the ends of the two pterygoid plates of the sphenoid bone; the

Fig. 20.*

middle fossa, which is very superficial, makes up a part of what is commonly called the *fossa pterygoidea.* The foreside of this pterygoid process is rough and irregular where it joins the back part of the great tuberosity of the maxillary bone. Frequently several small holes may be observed in this triangular process, particularly one near the mddle of its base, which a little above communicates with the common and proper holes of this bone already mentioned.

The *nasal lamella* of this bone is extremely thin and brittle, and rises upwards from the upper side of the external edge of the square bone, and from the narrow extremity of the pterygoid process; it is so weak, and, at the same time, so firmly fixed to the maxillary bone, as to be very liable to be broken in separating the bones. From the part where the plate rises, it runs up broad on the inside of the tuberosity of the maxillary bone, to form a considerable share of the sides of the maxillary sinus, and to close up the space between the sphenoid and the great bulge of the maxillary bone, where there would otherwise be a large slit opening into the nostrils. On the middle of the internal side of this thin plate, there is a transverse ridge, continued from one which is similar to it in the maxillary bone

* A posterior view of the palate bone in its natural position; it is slightly turned to one side to obtain a view of the internal surface of the perpendicular plate (2). 1. The horizontal plate of the bone; its upper or nasal surface. 2. The perpendicular plate or nasal lamella, seen on its internal or nasal surface. 3, 10, 11. The pterygoid process or tuberosity. 4. The broad internal border of the horizontal or palatine process, which articulates with the similar process of the bone of the other side. 5. The ridge which with a similar elevation of the opposite bone forms the palate spine. 6. The horizontal ridge which gives attachment to the inferior turbinated bone; the concavity below this ridge forms a part of the inferior meatus of the nose, and the concavity (2) above the ridge forms a part of the middle and superior meatus. 7. The spheno-palatine foramen. 8. The orbital process of the bone. 10. The middle facet of the pterygoid process or tuberosity which forms the middle of the pterygoid fossa. The fossæ 11 and 3, articulate with the two pterygoid plates of the sphenoid bone; 11 with the internal, and 3 with the external.

for supporting the back part of the os spongiosum inferius. Along the outside of this plate, the perpendicular fossa made by the posterior palatine nerve is observable.

At the upper and posterior edge of this nasal plate is a notch, which when applied to the sphenoid bone, forms the spheno-palatine foramen, through which a nerve, artery, and vein pass to the nostril; this notch forms two processes on the posterior part of the bone, the inferior of which is in contact with the internal plate of the pterygoid process of the sphenoidal bone, and has, therefore, been called by some French anatomists, the *pterygoid apophysis of the os palati.* The superior and anterior portion is the proper *orbitar process* of this bone, which is situated at the posterior part of the lower surface of the orbit, and forms a portion of it. This process of the os palati is hollow; and its cavity generally communicates with the contiguous cell of the os ethmoides. It has several surfaces, one of which is to be found in the orbit, and another in the zygomatic fossa.

Fig. 21.*

The palate square part of the palate bone, and its pterygoid process, are firm and strong, with some cancelli; but the nasal plate, and orbitar processes, are very thin and brittle.

The palate bones are *joined* to the maxillary, by the fore edges of the palate square bones; by their thin nasal plates, and part of their orbitary processes, to the same bones; by their pterygoid processes, and back part of the nasal plates, to

* The perpendicular plate of the palate bone seen upon its external or spheno-maxillary surface. 1. The rough surface of this plate, which articulates with the superior maxillary bone. 2. The posterior palatine canal, completed by the tuberosity of the superior maxillary bone. The rough surface to the left of the canal (2) articulates with the internal pterygoid plate. 3. The spheno-palatine or lateral nasal foramen. 4, 5, 6. The orbital portion of the perpendicular plate. 4. The pterygoid apophysis or spheno-maxillary facet of this portion. 5. Its orbital facet or process. 6. Its maxillary facet, to articulate with the superior maxillary bone. 7. The sphenoidal portion of the perpendicular plate. 8. The pterygoid process or tuberosity of the bone.

the pterygoid processes of the os sphenoides; by the transverse ridges of their nasal lamellæ to the ossa turbinata inferiora, and by the spines of the square bones to the vomer.

The Ossa Spongiosa, or Turbinata Inferiora.

The *ossa spongiosa,* or *turbinata inferiora,* are so named to distinguish them from the upper spongy bones, which belong to the os ethmoides; but these lower spongy bones are quite distinct, and connected in a very slight way with the upper jaw bones. They are rolled or convoluted, very spongy, and exceedingly light. Each of them is attached to the os maxillare superius, near the transverse ridge, by a hook-like process, and covers a part of the opening of the maxillary sinus. One end is turned towards the anterior opening of the nose, and covers the end of the lachrymal duct; the other end of the same bone points backwards towards the throat. The curling plate hangs down into the cavity of the nostril, with its convex side towards the septum. This spongy bone differs from the spongy processes of the ethmoid bone, in being less turbinated or complex, and in having no cells connected with it.

The Vomer.

The *vomer* is a thin flat bone, which forms the back part of the septum of the nose. Its posterior edge extends downwards from the body of the os sphenoides to the palatine processes of the ossa palati, separating the posterior nares from each other.

The figure of this bone is an irregular rhomboid. Its sides are smooth; and its posterior edge appears in an oblique direction at the back part of the nostrils. The upper edge is firmly united to the base of the sphenoid bone, and to the nasal plate of the ethmoid. It is hollow for receiving the processus azygos of the sphenoid, and where it is articulated to the nasal plate of the ethmoid, it is composed of two lamina which receive this plate between them. The anterior edge has a long furrow in it, where the middle cartilage of the nose enters. The lower edge is firmly united to the nasal spines of the

maxillary and palate bone. These edges of the bone are much thicker than its middle, which is as thin as paper; in consequence of which, and of the firm union or connexion this bone has above and below, it can very seldom be separated entire in adults; but in a child it is much more easily separated entire, and its structure is more distinctly seen.

Its situation is not always perpendicular, but often inclined and bent to one side, as well as the nasal plate of the ethmoid bone.

It is united above to the os sphenoides and the nasal plate of the ethmoid bone; before to the middle cartilage of the nose; and below, to the ossa palati and ossa maxillaria superiora.

Maxilla Inferior, or Lower Jaw.

The form and situation of this bone are so generally known, that they do not require description. To acquire an accurate idea of the lower jaw, it is, however, necessary to examine attentively its different parts: viz. the *chin*, or mental protuberance, the *sides*, the *angles*, and the *processes*.

In subjects where the bones are strongly marked, there is a prominent vertical ridge in the middle and most inferior part of the *chin* which becomes broad below so as to form a triangle, and on each side of this triangular prominence are transverse ridges; from these eminences the muscles of the lower lip originate.

On each side of the jaw, commonly under the second of the bicuspides, or small molar teeth, is the anterior maxillary or mental foramen, through which pass out branches of the inferior maxillary nerve and blood-vessels. This foramen, has a direction upward and backward. At a small distance behind these foramina, on each side, is the commencement of a ridge which continues backward until it forms the edge of the *anterior* or *coronoid process*. The *alveolar processes*, which form the upper edge of the jaw, are on the inside of this ridge; the alveoli or sockets corresponding with the roots of the teeth, in number and form. The lower edge of the jaw, which is

denominated the *base*, is round and firm, except at the angles, where it is thin.

The *angle* is formed at the posterior extremity of the *base:* in children it is obtuse; but in adults whose teeth are perfect, it is nearly rectangular. The masseter muscle is inserted into the lower jaw, at the *angle;* and there are several inequalities on the surface made by this muscle.

*Fig. 22.**

The *anterior* or *coronoid process*, is rather higher than the *posterior*, and forms an obtuse point: into this process the temporal muscle is inserted. The anterior edge of the *coronoid process* is sharp, and continued into the ridge above mentioned; from this edge the buccinator muscle arises. As the alveoli are on the inside of this edge and ridge, the jaw is very thick at this place. There is a semicircular or sigmoid notch between this coronoid process and the posterior or *condyloid;* and here the bone is very thin.

The *condyles* are oblong, and are placed *obliquely;* so that their longest axes, if extended until they intersect each other, would form an angle of more than one hundred and forty degrees. The neck of the process, or the part immediately below the condyle, is concave on the anterior, and convex on the posterior surface.

On the inside of the jaw, in the middle of the chin, is a small protuberance, sometimes divided by a vertical fissure; to this are attached the frænum linguæ, and some muscles of the

* The lower jaw. 1. The body. 2. The ramus. 3. The symphysis. 4. The fossa for the depressor labii inferioris muscle. 5. The mental foramen. 6. The external oblique ridge. 7. The groove for the facial artery. 8. The angle. 9. The extremity of the mylo-hyoidean ridge. 10. The coronoid process. 11. The condyle. 12. The sigmoid notch. 13. The inferior dental foramen. 14. The mylo-hyoidean groove. 15. The alveolar process. *i.* The middle and lateral incisor tooth of one side. *c.* The canine tooth. *b.* The two bicuspides. *m.* The three molares.

tongue and os hyoides. Farther back is a ridge called the *mylo-hyoid*, which extends backwards and upwards, until it approaches the alveoli of the last molar teeth; where it terminates in an oblong protuberance. To the anterior part of this line the mylo-hyoidei muscles are attached; and to the posterior extremity, the superior constrictor of the pharynx. The surface of the bone above this ridge is smooth, and covered with the gums and lining membrane of the mouth. The surface below the posterior part of the line is rather concave, to accommodate the submaxillary gland.

At a small distance behind the alveoli, and nearly on a line with them, midway between the roots of the two processes, is a *large foramen*, called the *inferior dental*, for transmitting the third, or inferior maxillary branch of the fifth pair of nerves, and the blood-vessels which accompany it; the canal, which commences here, terminates at the anterior foramen, already described.* The surface of this canal is perforated by many foramina, through which blood-vessels and nerves pass to the different teeth, and to the cancelli of the bone. On the *anterior side* of the foramen is a sharp-pointed process, from which a ligament passes to the temporal bone. The nerve and vessels, before they enter into this foramen, make an impression on the bone; and there is generally a small superficial groove called the *mylo-hyoid*, which proceeds downwards from it, being made by a small nerve which supplies some of the parts under the tongue.

At the angle of the jaw, on the inside, is a remarkable roughness, where the internal pterygoid muscle is inserted.

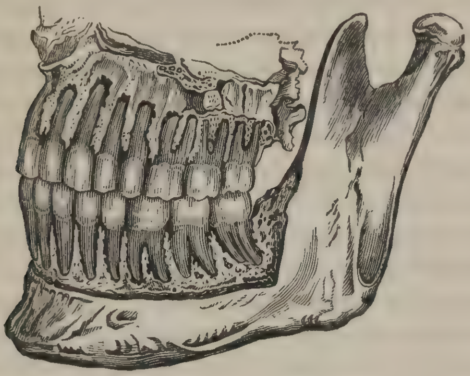
The lower jaw moves like a hinge upon its condyles in the glenoid cavity, when the mouth opens and shuts in the ordinary way. When the mouth is opened very wide, the condyles move forward upon the tubercles before the cavities: if the effort to open the mouth is continued, the lower jaw is fixed in that situation, and the whole head is thrown back, which separates the upper jaw still farther from the lower.

* A branch of this canal is continued forwards to the symphysis by which the front teeth are supplied with vessels and nerves.—P.

The lower jaw can be projected forward without opening the mouth, by the movement of both condyles, at the same time, on the tubercles.

This bone can also rotate upon one condyle, as a centre, while the other moves out of the glenoid cavity, upon the tubercle: but these important motions can be better understood, after the muscles, and the articulation with the temporal bone, in its recent state, have been described.

Fig. 23.



Of the Teeth.

In the adult, when the teeth are perfect, there are sixteen in each jaw, and those in corresponding situations, on the opposite sides, resemble each other exactly.

They are of four kinds, viz. *incisores*, or the fore teeth; *cuspidati*, or the canine; *bicuspides*, or the small grinders; and *molares*, or the large grinders.

On each side of the jaw, supposing it divided in the middle there are *two incisores, one cuspidatus, two bicuspides*, and *three molares.* They occur in the order in which they have been named, beginning at the middle of the jaw, as in the above figure.

Each tooth is divided into two parts, viz. the *body*, or that portion which is bare, and projects beyond the alveoli and

gums; and the *root*, which is lodged in the socket. The boundary between these parts, which is embraced by the gums, is called the neck of the tooth.

The *body* and *roots* consist of a peculiar kind of bone (*dentine*) which is more firm and hard than the substance of the other bones; but all the surface of the body, which projects beyond the gums, is covered with *enamel*, a substance very different from common bone.

Every tooth in its natural condition has a cavity in it, which commences at the extremity of each root, and extends from it to the body of the tooth, where it enlarges considerably. This cavity is lined by a membrane, and contains a nerve, with an artery and vein, which originally entered the tooth, by a foramen near the point of the root, as is evident during the growth of the teeth. These vessels, and the nerve, have been traced into the teeth; although in many subjects the foramina appear to be closed up.

—A third substance has lately been discovered by Prof. Retzius of Stockholm as entering into the composition of the teeth of man, called the *cortical substance* or *cementum*. It commences at the lower edge of the enamel and surrounds completely the fang. In many of the lower animals it is found also, on the faces of the compound teeth, filling up the spaces between the vertical ridges of enamel.—

Composition of the Teeth.

—The bone or ivory of the teeth, now called *Dentine*, (see Fig. 24,) constitutes the whole of the root, and a greater part of the body and neck. The cavity in the centre, for the lodgement of the pulp, *(cavitas pulpi)* in whichever of the teeth it is examined, presents an exact similarity of shape to the bodies and fangs of the teeth, as though the latter had been moulded upon the pulp. The ivory is of a polished pearly whiteness, like that of a piece of white satin. It is composed chemically both of animal and earthy matter, but in different proportions from ordinary bone. If exposed for a considerable

Fig. 24.

time to the action of a weak acid solution, the earthy matter is dissolved, and there is left a flexible, tenacious, dense, and homogeneous mass, much resembling cartilage, but more dense. If, on the contrary, it is exposed to the action of fire, the animal matter is first blackened, then consumed, and there is left a white, hard, friable residue of calcareous matter.

—The *enamel* or *vitreous substance*, (see Fig. 24,) so named from its resemblance to vitrified minerals, has been with greater propriety called by Blake, the *cortex striatum*, from the lines which it presents upon its sides. It forms a covering nearly a line in thickness upon the crown of the teeth, and is thinned down at its termination upon the neck. Its texture is fibrous, or consists of particles piled one upon another, perpendicularly to the bony part, and so closely compressed together, as to leave no obvious interval between them. All the wear of the teeth takes place, therefore, at the end of these fibres and not upon their sides; and the enamel is rendered by this arrangement much less liable to fracture.

—No vessels have been traced to this substance, nor has it ever been seen like the bony portion, coloured by madder in young animals fed on this substance during the developement of the teeth. But Mascagni, infatuated with his discoveries in the absorbent system, absurdly regarded this substance as entirely formed of absorbent vessels.* It is exceedingly hard and strikes fire, on collision with steel. While covering the bone, it presents a milky white appearance; removed from it, it is semi-transparent and opaline.

—The enamel is thickest on those parts of the teeth most exposed to friction, as on the horizontal surfaces of the grinders, the edges of the incisors, and the points of the cuspidati. The position of the enamel and its arrangement into fibres is well seen in Fig. 24.

* Vide Prodromo.

—The enamel and ivory of the teeth are the most indestructible after death of all parts of the body. In opening tumuli or other ancient places of sepulchre, they are frequently found to have undergone scarcely any decomposition.

—The *cortical substance* or *cementum*, see Fig. 24, consists of a thin osseous layer developed on the external part of the fangs, down to the orifices which lead to the cavity of the tooth. It is essentially of the same structure as true bone, containing the characteristic corpuscles, and calcigerous branching tubuli of that tissue. It is supposed to be formed by ossification of the capsule in contact with the fang, and is certainly the seat of the exostosis often met with on the roots of the teeth. In old age it makes its appearance in the cavity of the tooth, and is formed from the membrane of the pulp—the pulp shrinking and retiring in proportion as the cement accumulates.

—The chemical composition of the two substances of the human teeth, consists, according to Berzelius, in the hundred parts, of

	Enamel.	Bone.
Animal matter, - - - -	-	20.0
Phosphate of lime, with fluate of lime,	88.5 -	64.3
Carbonate of lime, - - - -	8.0 -	5.3
Phosphate of magnesia, - - -	1.5 -	1.0
Soda, with some chloride of soda, -	-	1.4
Free alkali and animal matter, -	2.0 -	
	100.0	100.0

—Purkinje and Müller, have recently, with the aid of the microscope, investigated very minutely, the structure of the teeth, and their discoveries have been confirmed by many other observers of high reputation. They describe the bony part of the tooth as consisting of fibres running parallel to each other from the external to the internal surface of the tooth, between which is placed a semi-transparent, homogeneous portion. These fibres they believe to be really tubular; for on

bringing ink into contact with them, it was drawn into them, as if by capillary attraction. These tubes Müller believed to be filled, at least partially, with calcareous matter, which was the cause of the whiteness and opacity of the tooth. In the more transparent part of carious teeth, the white substance in these tubes presented more of a granular, and less of a compact appearance, under the microscope, than in a sound tooth.

—The white colour and opacity of these tubes were removed by the application of acids. On breaking a thin lamella of a tooth transversely in regard to the fibres, and examining the edge of the fracture, he perceived the tubes, stiff, straight, and inflexible, projecting here and there from the surfaces. If the lamella had previously been acted on by acid, the tubes were flexible, transparent, and often very long. Hence Müller inferred that the walls of the tubes have a basis of animal tissue, and that besides containing calcareous matter in their cavity, they have this tissue in the natural state impregnated with calcareous salts. The greater part of the earthy matter of the tooth is, however, contained in the transparent homogeneous portion between the fibres, in which it can be rendered visible in a granular state by boiling thin lamina of teeth in a ley of potash.

—Purkinje, by the aid of high magnifying powers, discovered the corpuscles that characterise true bone, in layers taken from the external and internal surface of the root; he considers the great mass of the tooth, however, as destitute of organization.—

—These fibres which have been still more fully proved by Retzius* to be true canals, having their own walls, are differently arranged in the separate substances of the tooth, but are every where exceedingly minute. In the *ivory* they are about $\frac{1}{385}$th of a line in diameter: they commence by open orifices at the cavity of the pulp, and extend in an undulating but nearly parallel direction to the surface, dividing and branching

* Mikroskopiska Undersökningar öfver Tändernes särdeles Tandbenets, struktur: Stockholm, 1837.

in their course; the branches anastomosing together, and communicating occasionally with very minute calcigerous cells, lodged in the transparent intertubular structure, which may be compared to the corpuscles of ordinary bone.

The fibres or *filled* tubes of the *enamel* are about $\frac{1}{460}$th of a line in diameter, and are hexagonal. They are striated, arranged parallel to each other, and are applied by their internal extremities to corresponding depressions on the surface of the ivory.

—The ordinary bony tubuli of the *cement* or cortical substance communicate here and there with the branching tubes of the ivory.

—These minute but interesting details in regard to the structure of the teeth, which are found to vary in the different classes of animals, are important, not only as furnishing one of the best methods of their classification, but in exhibiting the striking analogy that exists, as to their structure, between teeth and bone. The tubes or canals of common bone are occupied by blood-vessels, the calcareous matters being lodged in the bony corpuscles and their reticular tubuli; while those of the teeth are vascular in the growing state, and become nearly all filled up as well as their corpuscles with earthy matter, to give that great degree of solidity requisite in biting and mastication.—

The *alveoli* or *sockets of the teeth*, are formed upon the edge of the jaw: the bone, of which they consist, is less firm than any other part of the jaws: they correspond exactly with the roots of the teeth; and are lined with a vascular membrane, which serves as a periosteum to the roots, and assists in fixing them firmly.

—They are developed *pari passu*, with the teeth, and solely for the purpose of giving them a lodgement; hence when the teeth are removed from the jaw, in the living subject, the sockets subsequently disappear by absorption, as being of no further use. There are two sets of alveoli, one for the deciduous teeth of the child, and one for the permanent teeth of the adult. Their walls are formed of one plate on the external

side of the jaw, and one on the internal, with transverse bony laminæ passing between them. On the side of the cavity which they form, their substance is loose and cellular; on their outer side, like other bones, they are smooth and compact.

—The transverse processes, are rather more prominent than the lateral part of the parietes, corresponding in this respect inversely with the line of enamel on the teeth.

—The enamel terminates on the neck of the teeth a little above the level of the sockets, leaving a small space on the bony part of the neck round which the gum is attached.

—The alveoli, terminate in as many hollow processes, as there are fangs to the teeth which they lodge: and at the bottom of each of these processes there are one or more minute foramina, for the transmission of vessels and nerves to the internal membrane and pulp of the teeth.

—The mode of articulation of the teeth in the sockets is called *gomphosis;* even in their perfect state, the teeth are slightly movable in the socket, of which dental surgeons, occasionally take advantage, in altering the direction of the teeth, by mechanical means. The firmness of the articulation, depends upon the adaptation in size and shape of the sockets to the fangs, on the gum which surrounds the neck, of the periosteum of the sockets which is continuous with that of the fangs, and of the vessels and nerves which enter into the foramina of the fangs.

The teeth of different kinds differ greatly from each other, in form and size.

The *body of the incisores is broad*, with two flat surfaces, one anterior and the other posterior; the anterior surface is rather convex and the posterior concave; they meet in a sharp cutting edge. At this edge the tooth is thinnest and broadest; it gradually becomes thicker and narrower, as it is nearer the neck. The enamel continues farther down on the anterior and posterior surfaces than on the sides.

The *incisores* of the upper jaw are broader than those of the lower; especially the two internal incisores.

The *cuspidati* are longer than any other teeth, and are thicker

than the incisors. Their edges are not broad, as those of the incisors, but pointed; this point is much worn away in the progress of life.

The enamel covers more of the lateral part of these teeth than of the incisors.

The *bicuspides* are next to the *cuspidati*, two on each side. They resemble each other strongly; but the first is smaller than the other, although it generally has a longer root. The bodies are flattened laterally, but incline to a roundish form. On the middle of the grinding surface are depressions which make the edges prominent. On the external edge there is generally one distinct point in each of the *bicuspides*. The internal edge is lower than the external in the first *bicuspis*, which gives it a resemblance to the *cuspidatus*. In the *second bicuspis*, the internal edge is more elevated, although the point is not so distinct as it is on the external edge.

The *bicuspides* have generally but one root, which is often indented lengthwise, so as to resemble two roots united.

The *three molares* or *large grinders* are placed behind the bicuspides, on each side. The first and second strongly resemble each other, but the third has several peculiarities. The body of the large grinders is rather square; the grinding surface has often five points, and three of these are on the external side. In the upper jaw these teeth have three roots, two situated externally, and one internally, which is very oblique in its direction; they are all conical in their form. It seems probable that the roots of these teeth are arranged in this way to avoid the antrum maxillare. The molares of the lower jaw have but two roots, which are flat, and are placed one anterior and the other posterior; in each of these broad roots there are two canals, leading to the central cavity; whereas, in each root of the upper molares there is but one. The third grinder is called *dens sapientiæ*, from its late appearance. It is shorter and smaller than the others; its body is rather rounder, and its roots are not so regular and distinct; for they are sometimes compressed together, and sometimes there appears to have been but one root originally, when the whole tooth has a conical

appearance. In some cases the dentes sapientiæ take an irregular direction, and shoot against the adjoining teeth.

Infants have a set of deciduous teeth, which differ in several respects from those of adults. They are but *twenty* in number; the five on each side of each jaw, consist of two incisores, one cuspidatus, and two molares or large grinders. The first of them generally protrudes through the gums between the fourth and eighth months of age; the last about the end of the second year. They commonly appear in pairs,* which succeed each other at irregular intervals. Those of the lower jaw are, in most cases, the first. The order of their appearance is this: the central incisors appear first, then the external incisors on each side; after these the first molaris, then the cuspidatus, and finally the last molaris on each side. There are many deviations from this order of succession, but it takes place in a majority of cases.

These deciduous teeth become loose, and are succeeded by those which are more permanent, nearly in the same order in which they appeared, but with a progress much more slow. The incisores generally become loose between the sixth and seventh year; the first molares about the ninth, the cuspidati and the second molares not until the tenth or twelfth, or even fourteenth year. The bicuspides take the places of the infant molares.

The three permanent molares appear in the following order: the first of them protrudes a short time before the front teeth are shed; it is the first of the permanent teeth which appears, and is seen between the sixth and seventh year. The second molaris appears soon after the cuspidati and the second bicuspides are seen. There is then a long interval; for the last molaris or dens sapientiæ is seldom seen before the twentieth year, and sometimes not until the twenty-fifth.

The teeth are formed upon pulpy substances, which are situated in the alveoli, and are contained in capsules. A shell of bone is first formed upon the surface of the pulp, which

* The two teeth of a pair do not appear at the same precise time, but very near to each other.

gradually increases, and the pulp diminishes within it. The body of the tooth is produced first, and the root is formed gradually afterwards; during its formation the root has a large opening at the extremity, which is gradually diminished to the small orifice before described. The roots, as well as the body, are formed upon the pulpy substance, which gradually diminishes, as they increase. After the external surface of the body of the tooth is formed, the enamel begins to appear upon it, and gradually increases, until it is completely invested. It is probable that the enamel is deposited upon the body of the tooth by the membranous capsule which contains it. This substance, which appears to be formed of radiated fibres, is harder and less destructible than bone. Like the substance of bone, it is composed of phosphate, with a small proportion of the carbonate of lime; but it is destitute of the cartilaginous or membraneous structure which is demonstrable in bone.

The pulpy substances, or rudiments of teeth, may be seen in the fœtus, when about four months old. At six months, ossification can be seen to have commenced on the pulps of the incisores. At the time of birth, the *bodies* of the infant teeth are distinctly formed. The alveoli, at first, have the appearance of grooves in the jaw, which afterwards are divided by transverse partitions; they enlarge, in conformity to the growth of the teeth, and appear to be altogether influenced by them.

The permanent teeth are formed very early: the rudiments of the first permanent grinder on each side have commenced their ossification at birth. At the same time, the rudiments of the permanent incisors are to be perceived; and their bodies will be found nearly ossified, by the time the infant incisors are protruded completely through the gums. About the age of six years, if none of the infant teeth are shed, there will be forty-eight teeth in the two jaws, viz: the twenty infantile, and twenty-eight permanent teeth, more or less completely formed.

—From their mode of developement, apparent structure, and

connexions with the rest of the economy, the teeth were prior to the microscopical researches above detailed considered analogous to the hair, nails, and feathers of mammiferæ and birds, and to the shells of molluscæ. It cannot be said that the teeth are absolutely inorganized, that they are mere concretions of an effused fluid, since there is no part appertaining to living beings, entirely destitute of life; but in the *hard structure* of the teeth, no anatomist has yet demonstrated either vessels or nerves, though there are practical dentists, who assert that they have seen blood issue from the bony part of the teeth, in some of their operations.*

* Hunter denies positively the existence of any vessels passing between the pulp and bone of the teeth, as he was not able to render them manifest by injection, as the colouring matter does not pass into them when animals are fed upon madder, *except in the forming state*, and as they do not share in the general softening of the bones, in rickets and malacosteum. Blake believed that these vessels did exist, but were difficult to demonstrate, like those that we know to pass in the eye from the capsule of the crystalline lens, to the lens itself; Beclard, that there were no vessels in the bone of the teeth, continuous with those of the pulp, but that the former received continually from the latter a nourishing liquid which penetrated it by imbibition, and that it was situated in regard to the pulp, as the hair and nails to the vascular part of the skin. But the morbid alterations which take place in the body of the teeth, the softening and exostosis seen frequently at their roots, and the fusion of the latter occasionally to the bottom of the alveoli, render their vascularity highly probable.

The fang of a perfectly developed tooth, is covered closely by a membrane, called its periosteum, which is continuous with the periosteum of the socket, and is on all hands admitted to be vascular; the internal cavity is also lined by a highly nervous and vascular membrane. Both of these are intimately connected with the bony structure of the tooth, and require a little force to separate them. This connexion Mr. T. Bell believes to be made by vessels and probably nerves, which pass between them and the bone. Though no artificial injection has been made of the teeth, this writer has seen them tinged with a bright yellow in a young woman who died of jaundice; and where death has taken place from hanging or drowning, when there is usually a congestion of the capillary system, "he has found the osseous part coloured with a dull deep red which could not possibly take place if they were devoid of a vascular system; in both instances the enamel remained wholly free from discoloration." I have observed the same thing in the teeth of subjects who have died of cholera. The existence of nerves in the bony part of the teeth Bell considers manifested by the facts commonly observed by dentists; in filing the teeth no pain whatever is produced till the enamel is removed; but the instant the file begins to act upon the bone, the sensation is exceedingly acute: and when the gums, alveoli and periosteal lining membrane, have receded from the teeth so as to leave the bony part bare, it is exquisitely sensitive when touched with any hard instrument.

He admits likewise the existence of absorbents in the bony part of the teeth, for in

—If the pulp which produces them be destroyed from any cause, they lose the little vitality that they may possess, become foreign bodies mechanically retained in the living parts, and sooner or later are thrown off.

—The teeth are distinguished from the common bony tissue, by the absence of any demonstrable cellular or vascular parenchyma in their composition, by their being in part exposed to the contact of the atmosphere, which no bone can be without losing its vitality, by the enamel which covers them externally, by their successive evolution and renovation at certain periods of life, and lastly by their wearing out, and being lost in old age, whilst the vital actions are still going on in the rest of the economy.

—In many of the lower animals the teeth are evidently a production of the skin or dermoid tissue, which is reflected in at the commencement of the digestive passages, and many modern anatomists have for the reasons above mentioned, connected them with the description of the digestive organs. They have, however, again been restored for purposes of convenience to the student, to their proper connexion with the bones in which they are developed.

Developement of the Teeth.

—The teeth, as we have before observed, are developed on a principle different from that of other parts of the body, by *germs* or *gemmules*. If the jaws of a fœtus are examined with care, even at the period of two months* after conception, an extremely soft, jelly-like substance is seen lying along the edge of each maxillary arch. At the third month it is more consistent, and two plates of bone have sprung up at its sides, which are the rudiments of the external and internal alveolar plates. Shortly after this period, the pulpy substance separates into distinct portions, and rudiments of the transverse plates of

a tooth in which inflammation had existed for a considerable time, he found after its extraction an abscess in the very centre of the bony structure, communicating with the natural cavity and filled with pus.—P.

* T. Bell.—Beclard.

the alveoli are seen shooting across, from side to side. These distinct portions of the pulpy substance, are the germs or rudiments from which the teeth are formed; each is partially enclosed in a sac, and receive branches from the vessels and nerves which run along the bottom of the groove. At the fourth month, the enveloping sac is thick in its texture, and consists of two layers, which are easily separated after a short maceration. Both of these layers, Fox and T. Bell have proved, by their injections, to be vascular:* laying loosely within this double sac is the gelatinous vascular pulp itself, covered by an extremely thin, delicate vascular membrane, (to which it is closely united by vessels,) which secretes the bony part of the tooth, and is a sort of internal periosteum.† The pulp and its membrane receive their vascular and nervous filaments from the proper dental vessels and nerves, which run along the groove in the jaw. The double saccular membrane receives its vessels and nerves solely from the gums; and the only attachment between this and the membrane of the pulp, is near the base of the latter, where the dental vessels enter it. The sac is closely united to the gum, hence if we tear away the gum that covers the jaws, we necessarily bring with it the entire structure of the germ.

—If at this period, the fourth month, we open the germ, we find the pulp presenting exactly the size and shape of the body of the teeth first cut, (incisors) and that its membrane has already commenced the deposit of its bony tip.

—At birth, ossification will be found to have commenced on all the pulps of the temporary teeth, (the body of the incisors being nearly completed,) and on each of those of the anterior permanent grinders. The commencement of ossification is by three points in the incisors, which form their serrated edges

* Hunter declared, that the external is soft and spongy, without any vessels; the other much firmer, "and extremely vascular." Blake on the contrary asserts, that the external is spongy and full of vessels, the internal one is more tender and delicate, and seems to contain no vessels capable of containing red blood.

† This membrane is called by Bell the proper membrane of the pulp, and was conjectured by Blake, with much probability, to be a "propagation of the periosteum of the jaw." Blake on the Teeth, p. 8.—

as seen on their first developement, by a single point for the canine, two for the bicuspide, and three, four, or five on the large molar, according to the number of processes which they present. Continuous deposition of the bony matter from the membrane of the pulp, unites these points together, and by degrees at different epochs, all the bodies are formed; the pulp retiring as it were, as the deposition of bone goes on and encroaches upon its cavity, and elongates itself downward, into the shape of the fang. This is finally formed in the same manner as the bodies, and the pulp is completely enclosed in the bony case of the tooth, except at the foramina where the vessels and nerves enter. Where more than one fang exists to a tooth, the lower part of the pulp, is previously divided into an equal number of processes, by little bony partitions which shoot across from the sides of the alveoli.

Of the Enamel.

—When the devolopement of the bony shell has proceeded as far as the completion of the body and neck, the internal layer becomes thickened and more vascular, receives a greater amount of blood, becomes closely attached to the neck, and forms a loose capsule over the body. From the internal face of this membrane, is poured out a thickened whitish fluid, which Berzelius considers of the nature of lactic acid, which is speedily consolidated into a dark chalky substance, deposited first upon the tips of bone, and gradually extending down in layers till it covers the whole crown of the teeth. This is the enamel. It becomes gradually whiter and harder, as though by a more perfect crystallization, but (near to the period at which the teeth are cut,) it is still so soft, as to be frequently cut with the gum lancet.*

* In man, the enamel is formed solely by the inner membrane of the sac. The external contributes nothing to the structure of the teeth. But in graminivorous animals, where the flinty covering of the food they feed on requires a more perfect grinding apparatus, it performs an important part, in adding another element to the structure of the molar teeth, called by Blake *crusta petrosa*. The cutting teeth are constructed as those of man. In these animals the enamel of the grinders does not form a continuous smooth layer as in man, but passes a little way into the body of the teeth, and is arranged in the form of vertical layers, between which after the

—Of the three membranes of the germ or follicle, one only may be considered as permanent, that of the pulp or internal, which secretes the bone of the tooth.

—The two outer, or those of the sac, cover the crown of the tooth; and as this is pushed forwards by successive depositions of bony matter from within, they are pressed upon and wasted away by absorption, like the gum, in direct proportion with the advancement of the tooth, so that in perfectly natural dentition, there is little tension or pressure felt. This is called *cutting* the teeth, a name which expresses the fact, sufficiently well, but literally conveys a wrong idea.

—In cases of difficult dentition, the membranes of the sac retain their density and vascularity, and are probably thickened by inflammation, and the bony layers formed from the pulp, resisted in their advancement by these membranes, make compression upon the pulp and dental nerves; this, like continued pressure made in other parts of the body, becomes exquisitely painful, and gives rise to distressing sympathetic disturbances. The relief procured by cutting the gums and sac, will be more or less immediate, according to the degree of compression and inflammation of the pulp.

—The periosteum covering the fangs of the tooth, is a reflected continuation of the periosteum lining the socket, and this again is continuous with that lining the jaw.

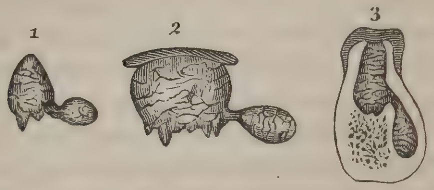
Of the Permanent Teeth.

—The adult or permanent teeth, are developed in a manner almost exactly analogous to the deciduous or infantile. The germs of many of them are distinctly perceptible in the gums of the infant at birth. They are placed at first deep in the jaw

inner membrane of the sac has been removed by absorption, the outer one, according to Bell, deposits the *pars petrosa*, and fills up the intervening space. This is a substance harder than the bone, but softer than the enamel; and the advantage derived from it is, that it is worn off by trituration more readily than the enamel, so that the latter is constantly maintained in sharp prominent lines upon the surface of the teeth. The same object is here insensibly attained, as a natural consequence of the difference in density of these parts, which the miller effects with much labour with his pick-hammer, on the burr-stones of his mill.—P.

at the inner side of those of the deciduous teeth, to the sac of which they are attached at top by a neck-like process, as seen in Fig. 25. As the infantile teeth rise up and make their way

Fig. 25.



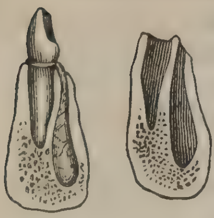
through the gum, this process becomes connected with the gum, and forms what is called by Hunter the gubernaculum dentis, from its influence in giving the permanent teeth their proper vertical direction, and preventing their making their way at random through the sides, as they do occasionally in cases where the gubernaculum has been destroyed.

—Delabarre has given the gubernaculum the name of *iter dentis*, from an erroneous belief that it was tubular, like the duct of a sebaceous follicle, and gradually opened as the tooth progressed.

—At the fifth month of fœtal life, according to Bell, and the eighth and ninth, according to Blake and Fox, the germs of the first permanent molars, may be seen at the outside of the infantile row, and those of the permanent incisors behind the deciduous. Fig. 25—1, 2, shows the attachment of the incisor and molar germs of the two sets, just prior to the eruption of the first. The permanent germ is at first placed in the socket of the deciduous tooth, of which it *appears*, on first view, to be an offshoot or gemmiperous production. Its vessels and nerves are believed to be mere branches of those of the deciduous set. By degrees a distinct socket is formed for it behind the latter, and its process or gubernaculum is elongated, as seen in Fig. 25—3. When the deciduous teeth have cut the gum, the two sockets are completely distinct, as seen in Fig. 26, and the gubernaculum is attached to the gum.

—Ossification first commences in the permanent set on the anterior molares, and may be seen at birth; at the age of

Fig. 26.



twelve months, it has progressed to a considerable extent upon these as well as upon the incisors and the lower cuspidata. At the sixth or seventh year of age the whole of the permanent teeth are more or less ossified, and the incisors are so far completed as to be nearly ready to make their appearance through the gum. At this period there are no less than forty-eight teeth in the two jaws, the twenty deciduous and the twenty-eight permanent, which are in different degrees of developement. The last molars do not begin to ossify till the ninth year, and are the last of all to make their appearance through the gum, whence they have received the name of *dentes sapientiæ* or wisdom teeth.

—The permanent teeth, which are more in number and individually of larger size and form a larger arch than the temporary, are developed at successive intervals, so as to correspond exactly, with the increasing size of the jaws from the infantile to the adult state. Hence they cannot correspond in position with the deciduous teeth; the outer permanent incisor will rise up near the cuspidatus, and the permanent cuspidatus near the first molar of the deciduous set.

—Exactly in proportion as the bodies of the permanent teeth are completed and approach the gum, the roots of the deciduous are removed by absorption, till finally the bodies of the latter only are left fixed mechanically in the gum, and are tumbled off at the slightest effort. The process of the removal of the fangs is not perfectly understood; it is not as was once supposed produced by the pressure of the subjacent tooth, for very frequently the commencement of absorption is at the neck, and not at the root of the tooth, where no pressure can come, and occasionally takes place even where the germ of the permanent tooth has been destroyed. It is more probably owing to the enlarged vessels of the growing permanent teeth, which come from the same branch with those of the deciduous, carrying off all its blood by derivation, which leads to the

wasting of the latter set, a process of which we find the analogue in the developement of many parts of the fœtus.

—Below is a tabular view of the appearance of the temporary teeth, and also of the periods at which they are changed for the permanent.

—It is to be taken, however, as a general rule liable to continual exceptions, not only in regard to the time, but also as to the regular order of appearance. As a general rule, the teeth of the lower jaw appear first, then the corresponding teeth of the upper.

Deciduous Teeth.

From	5	to	8	months,	the	four central incisors,
"	7	"	10	"		four lateral incisors,
"	12	"	16	"		four anterior molares,
"	14	"	20	"		four cuspidati,
"	18	"	36	"		four posterior molares.

Permanent Teeth.

—The first permanent molares usually pierce the gum before the fall of the central incisors, and their appearance indicates the approaching change.

—The following are about the medium periods at which they are cut, but there is a great degree of variation in this respect. Those of the lower are here indicated, and they most commonly precede the upper by about two or three months.

About	6½	years,	the anterior molares,
"	7	"	central incisors,
"	8	"	lateral incisors,
"	9	"	anterior bicuspides,
"	10	"	posterior bicuspides,
11	to 12	"	cuspidati,
12	" 13	"	second molares,
17	" 19	"	third molares or *dentes sapientiæ.*

—Fig. 8 is a side view of a beautiful set of the permanent teeth of both jaws, fitted in their sockets, showing the exact manner in which the surfaces of each set are adjusted to each

other, and the smaller dimensions of the fangs of the wisdom teeth, owing to the contracted space in which they are developed. These teeth decay early, are comparatively of little utility, and probably from the same cause; for in cases, where prior to their developement one of the molares in front of them have been removed, they take a more forward position, are developed with larger fangs, and become much more serviceable.

—When the first teeth have made their appearance through the gum, they are not yet completed; the process of thickening the body by layers from within, and of lengthening the root below, is for a time still continued by the pulp. After their completion, the only physiological changes they undergo, is the wearing down of the bodies by friction, and the filling up of the top of their cavity within by the pulp, with a yellowish bony matter in old age, (*cementum*,) which prevents the exposure of the cavity, and protects the vasculo-nervous pulp, which is so exquisitely sensitive, as to be considered by some in the light of a nervous ganglion. This latter process unhappily is not universal, and is especially defective when the teeth decay early in life, apparently before the period nature has assigned them.

Aberrations of Dentition.

—Occasionally at birth teeth have been found developed on the surface of the gum, as in the cases of Louis XIV. of France and Richard III. of England: in such cases they are generally mere shells, and are quickly shed, and below exist the double series of germs, which are developed in the regular order.

—In some rare cases, from the non-existence or disease of the germs, no teeth have ever been developed.* Borelli mentions a case of this sort occurring in a woman then seventy-two years old.

—Sometimes the temporary teeth only exist, which fall at the regular period and are never replaced. Occasionally the set

* Oudet. Consid. sur la Nature des Dents et leur Altcrations; Journal Univ. Des Sciences Med. tom. 43, 1826.

of permanent teeth have consisted of double or molar teeth all round. Sometimes the appearance of the temporary teeth has been protracted to the sixth or seventh year, and even then followed at regular intervals by the permanent set. The number of the permanent teeth are sometimes less than usual, in consequence of the non-developement of the wisdom teeth, which remain locked up in the jaw, and occasionally produce pain, and even abscesses in the bony structure.

—Sometimes there are supernumerary teeth. Haller has seen in an infant of fourteen years, seventy-two teeth, thirty-six in each jaw, which appeared to depend upon a greater number than usual of the dental germs. Some, fond of the marvellous, have described the eruption of a third set of teeth analogous to the two first: but according to Hudson and others, this appearance has probably been owing to the tardy removal of the deciduous set, and the late supplial of their place by the permanent teeth.

—Sometimes the direction of the teeth is vicious, leading into the ramus of the jaw, or upon the outer or inner surface of the gums; or upon the roof of the mouth. Accidental developements of teeth have likewise been met with in the orbit, the tongue, pharynx, stomach, and not unfrequently in the ovaries and uterus.—

Os Hyoides.

The *os hyoides* is a small insulated bone, supported between the lower jaw and the larynx, by muscles and ligaments, which proceed from the neighbouring parts in various directions.

The figure of this bone, as its name imports, resembles the Greek letter υ. In its natural situation, the central and convex part is anterior, and the lateral portions extend backwards.

The central part is called the *body*, and the lateral portions the *cornua*.

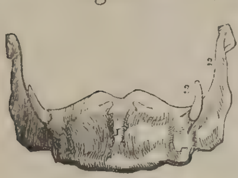
The *body* is broad and its upper edge bent inwards, so that the external surface is convex, vertically, as well as horizontally. On this surface is a horizontal ridge: the muscles which proceed from the lower jaw are generally inserted

above this ridge, and the muscles from the sternum and scapula below it.

The internal or posterior surface of the body is very concave.

The *cornua*, in young subjects, are distinct from the body of the bone, and joined to it by cartilages: near the body of the os hyoides they are flat; but their figure soon changes, and they terminate on each side in a small tubercle.

Fig. 27.*



On the upper edge of the bone, where the cornua unite to the body, is a process, equal in size to a small grain of wheat, which has a direction upwards and backwards; this is called the *appendix*, or lesser cornu of the os hyoides: from it proceeds a ligament which is attached to the styloid process of the temporal bone, and is sometimes ossified.

The basis of the tongue is attached to the os hyoides, and the motions of the bone have a particular reference to those of that organ; but they will be better understood when the parts with which it is connected have been described.

Regions of the Skull.

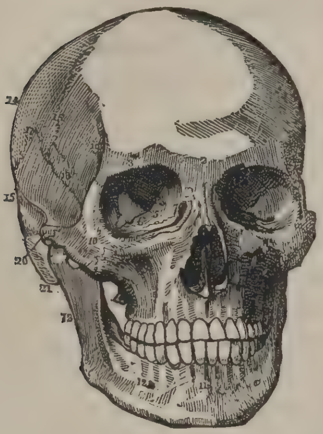
—The skull considered as a whole may be divided for the occasional purpose of defining the seats of injuries into four regions.

—The *superior region* or *vertex*, is bounded anteriorly by the frontal eminences; on each side by the temporal ridges and parietal eminences, and behind by the superior curved line of the occipital bone and occipital protuberance. The *anterior region* or *face* as seen in Fig. 28, is somewhat oval in contour, irregular in surface and excavated for the reception of two principal organs of sense, the eye and the nose. It is formed in part by the frontal bones and by the bones of the face. It is

* The os hyoides seen from before. 1. The anterior convex side of the body. 2. The great cornu of the left side. 3. The lesser cornu of the same side. The cornua were ossified to the body of the bone in the specimen from which the figure was drawn.

bounded above by the frontal protuberances, below by the chin, and on the sides by the malar bones.—If a perpendicular line be drawn down the face from the inner third of the supraorbital ridge to the inner third of the body of the lower jaw, it will intersect three foramina, the supra-orbital, infra-orbital, and mental, each giving passage to one of the facial branches of the fifth nerve, the common seats of facial neuralgia.

Fig. 28.*



The *lateral region* or *side of the head*, comprises the temporal and zygomatic fossæ and the mastoid portion of the temporal bone.

—The *inferior region* or *base* of the skull, is very irregular and presents an *internal* or cerebral and an *external* or basilar surface.

—From the importance of the vessels and nerves which traverse it, this region requires to be particularly studied.—

An acquaintance with the individual bones which compose the head is principally useful, as it leads to a perfect understanding of the whole structure, of which each bone is but a small part.

This structure comprises the cavities which contain the brain and the most important organs of sense, as well as the foramina subservient to them, which are of so much importance in the practice of medicine and surgery, and also in physiology, that the following descriptions are subjoined.

Orbit of the Eye.

The figure of this cavity is that of a quadrangular pyramid with its angles rounded; so it resembles a cone, the bottom being the apex and the orifice the base.

* A front view of the skull. 1. The anterior portion of the frontal bone. 2. The nasal protuberance. 3. The supra-orbital ridge. 4. The optic foramen. 5. The sphenoidal fissure. 6. The spheno-maxillary fissure. 7. The lachrymal fossa in the lachrymal bones, the commencement of the nasal duct. The figures 4, 5, 6, 7.

The diameter of the cavity passes obliquely outward from the apex behind. As the figure is irregular, the side next the nose does not partake of this general obliquity, but extends in a straight direction from behind forwards.

The orbit is somewhat contracted at its orifice, and enlarged immediately within. The form of the orifice is rather oval, as the transverse diameter is longer than the vertical. Seven bones are concerned in the formation of this cavity; the os frontis and a portion of the lesser wing of the sphenoid bone above, the os planum of the ethmoid, the os unguis, and the nasal process of the upper maxillary bone, and the os palati below; the os malæ, and orbitar plate of the sphenoid bone, on the outside.

On the *upper surface* is the depression for the lachrymal gland; and at the orifice is the notch or foramen for the supra-orbitary vessels, &c., which have already been mentioned.

On the *inner surface* are two longitudinal sutures, which connect the os planum and the os unguis to the os frontis above, and the os maxillare below. In the upper suture are the two internal orbitary foramina mentioned in the description of the os frontis, the anterior of which transmits a fibre of the ophthalmic nerve, with an artery and vein; the posterior transmits only an artery and vein. There are also two smaller vertical sutures on each side of the os unguis. On the anterior part of this inner surface is the ridge of the os unguis, and the grooves for accommodating the lachrymal sac, which passes into the canal of the same immediately below.

On the *lower surface* is the aforesaid canal, formed by the nasal and orbitar process of the upper maxillary bone, and that part of the os unguis which is anterior to the ridge. On the posterior part of this surface is a groove which proceeds for-

are within the orbit. 8. The opening of the anterior nares, divided into two parts by the vomer: the number is placed upon the latter. 9. The infra-orbital foramen. 10. The malar bone. 11. The symphysis of the lower jaw. 12. The mental foramen. 13. The ramus of the lower jaw. 14. The parietal bone. 15. The coronal suture. 16. The temporal bone. 17. The squamous suture. 18. The upper part of the great ala of the sphenoid bone. 19. The commencement of the temporal ridge. 20. The zygoma of the temporal bone, assisting to form the zygomatic arch. 21. The mastoid process.

wards, and penetrating into the bone, becomes a canal that terminates in the infra-orbitar foramen ; this groove in the bone is made a canal by the periosteum. The thin plate which forms this surface is the partition between the antrum maxillare and the orbit of the eye, and is more or less absorbed in those cases where polypi of the antrum maxillare occasion a protrusion of the eye.

The *external surface*, formed by the malar bone and the orbitar plate of the sphenoid, is almost flat. In the posterior part of the orbit it is bounded by two large fissures, which are now to be described.

In the posterior part of the orbit are three apertures. The optic foramen, the sphenoidal fissure, and the spheno-maxillary fissure.

The optic foramen opens almost at the bottom of the orbit on the inside ; its direction is forwards and outwards.

The sphenoidal fissure, formed principally by the lesser and greater wings of the sphenoidal bone, begins at the bottom of the orbit, and extends forward, upward, and outward. It is broad at the commencement, and gradually diminishes to a fissure. This fissure opens directly into the cavity of the cranium, and admits the passage of the third, fourth, sixth, and one branch ofthe fifth pair of nerves, and an artery, and a vein.

The spheno-maxillary fissure commences also at the bottom of the orbit, and extends forward, outward, and downward, between the maxillary bone and the orbitar plate of the sphenoid, from the body of the sphenoid to the malar bone. This fissure opens from the orbit directly into the zygomatic fossa. In the recent subject it is closed, and only transmits the infra-orbitary nerve and vessels, and a small branch of the superior maxillary nerve.

The Cavities of the Nose.

These cavities, which are separated from each other by the septum narium, are contained between the cribriform plate of the ethmoid and the palatine process of the upper maxillary and palate bones, and between the anterior and posterior nares.

They are, therefore, of considerable extent in these directions; but the distance from the septum to the opposite side of the nose is so small, that each cavity is very narrow.

The *upper surface* of each cavity consists of that portion of the cribriform plate of the ethmoid which is between the septum and the cellular portions. Anterior to this, each cavity is bounded by the *internal surface* of the *os nasi* of its respective side; and posterior to it, by the *anterior surface of the body of the sphenoid bone.* These anterior and posterior surfaces form obtuse angles with the upper surface of the nose, and are immediately above the openings called anterior and posterior nares. The *anterior surface* partakes of the figure of the os nasi; the *upper surface* has the perforations of the cribriform plate; the *posterior surface* has an opening, equal in diameter to a small quill, that leads into the sphenoidal cell, and is also broader than the anterior or superior surface.

The *internal surface*, formed by the septum of the nose, which is composed of the vomer, the nasal plate of the ethmoid, and the cartilaginous plate, is flat, but rather inclined to one side or the other, so as to make a difference in the size of the nasal cavities.

The *external surface* is very irregular; it is formed by the *cellular portions* of the *ethmoid;* by a small portion of the *os unguis;* by the *upper maxillary bone;* the *os turbinatum inferius;* the *os palati;* and the *internal pterygoid process* of the *os sphenoides.* The upper part of this surface is formed by the internal surface of the cellular portions of the ethmoid, which have been described at page 76. It extends from the sphenoid bone, very near to the ossa nasi; and is uniformly flat and rough.

About the middle of it begins a deep groove, which penetrates into the cellular structure of the ethmoides, and passes obliquely downwards and backwards. At the upper end of this groove is the foramen by which the posterior ethmoidal cells communicate with the nasal cavity.

This is the *upper channel* or *meatus* of the nose. At the posterior end of it is a large foramen formed by the nasal

plate of the os palati and the pterygoid process of the os sphenoides, and therefore called *pterygo* or *spheno-palatine* foramen. It opens externally, and transmits a nerve and an artery to the nose.

Below the meatus is the upper spongy bone, which presents a convex surface; its lower edge is rolled up and not connected with the parts about it. This spongy bone covers a foramen in the ethmoid bone, by which its anterior cells and the frontal sinuses communicate with the nose.

Below this spongy bone is the *middle channel*, or *meatus* of the nose. The *channel* extends from the anterior to the posterior part of the cavity. It is very deep, as it penetrates to the maxillary bone. The cells of the ethmoid are above it; the inferior turbinated bone below it; and the upper spongy bone projects over it. In this channel is the *opening of the great cavity* of the upper maxillary bone. At the anterior extremity of it is a small portion of the *os unguis*, which intervenes between the nasal process of the upper maxillary bone and the cells of the ethmoid, and continues down to the lower spongy bone.

The *lower spongy bone* is nearly horizontal, and very conspicuous. It extends almost from one opening of the nose to the other. Under this bone is the *third and largest channel* or *inferior meatus* of the nose. It is made large by an excavation of the upper maxillary bone, particularly at the anterior part. It affords a direct and very easy passage to the posterior opening of the nose and the throat.

Near the anterior extremity of this meatus is the lower orifice of the lachrymal duct, which is so situated that a probe properly curved can be readily passed into it through the nostril.

There are, then, four foramina on each side, which form communications between the cavities of the nose and the adjacent cells, viz.

One in the upper meatus, which leads to the posterior ethmoid cells.

A second in the middle meatus, which leads to the anterior ethmoid cells and the frontal sinuses.

A third in the same meatus, which opens into the maxillary sinus.

A fourth in the anterior surface of the body of the sphenoidal bone, which opens into the sphenoidal sinus.

To these must be added the opening of the lachrymal canal.

It will be most useful to the student of anatomy, after placing three or four of the uppermost cervical vertebræ in their natural situation, to take a view of

The Cavity between the spine and the posterior Nares, which is bounded *above,* by the cuneiform process, passing obliquely upward and forward; *laterally,* by soft parts not yet described; *behind,* by the bodies of the cervical vertebræ; and *before,* by the posterior nares, each of which is oblong in form, rounded above, flat below, and separated from the other by a thin partition, the vomer.

The Cavity of the Cranium.

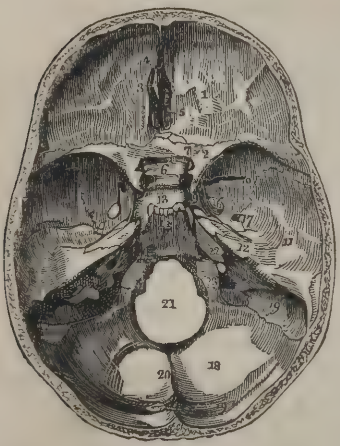
The upper concave surface of this cavity corresponds with the figure of the cranium. The ridge in it for supporting the falciform process of the dura mater, the groove made by the longitudinal sinus, the impressions of the arteries, and the pits made by the convolutions of the brain, are particularly to be noticed.

The Internal Basis of the Cranium

Is much more important. It is divided into three fossæ on each side; the anterior of these are most superficial, and the posterior the deepest. The bottoms of the *anterior fossæ* are formed by the *orbitar processes* of the *os frontis,* and consequently are convex; between them is the *cribriform plate* of the *ethmoid,* which is commonly sunk below the adjoining surface. The *crista galli* is very conspicuous; and the foramen cæcum can almost always be seen. The crista galli is evidently the beginning of the prominent ridge, which continues on the os frontis, and supports the falx of the dura mater. The posterior margins of these fossæ are formed by the lesser wings of the sphenoid bone.

The *middle fossæ* are formed by the great wings of the sphenoidal bone, and by the squamous and petrous portions of the temporal bone. They are lower than the anterior, and higher than the posterior fossæ. The projection of the margin of the anterior fossæ into these cavities, corresponds with the separation between the anterior and middle lobes of the brain. The suture between the sphenoidal and temporal bones is evident in these fossæ. The upper surface of the body of the sphenoid bone, or the sella turcica is between them; and all the peculiarities of its surface are very conspicuous. The first five foramina of the sphenoidal bone can be easily ascertained, and also, the anterior foramen lacerum and termination of the foramen caroticum, with the impressions made by the carotid arteries on the sides of the sella turcica. The petrous portions of the temporal bones are the posterior boundaries of the middle fossæ. Their oblique direction, inwards and forwards, is particularly remarkable; being formed

Fig. 29.*



* The cerebral surface of the base of the skull. 1. One side of the anterior fossa; the number is placed on the roof of the orbit, formed by the orbital plate of the frontal bone. 2. The lesser wing of the sphenoid. 3. The crista galli. 4. The foramen cæcum. 5. The cribriform lamella of the ethmoid. 6. The processus olivaris. 7. The foramen opticum. 8. The anterior clinoid process. 9. The carotid groove upon the side of the sella Turcica, for the internal carotid artery and cavernous sinus. 10, 11, 12. The middle fossa of the base of the skull. 10. Marks the great ala of the sphenoid. 11. The squamous portion of the temporal bone. 12. The petrous portion of the temporal. 13. The sella Turcica. 14. The basilar portion of the sphenoid bone, surmounted by the posterior clinoid processes. 15. The foramen rotundum. 16. The foramen ovale. 17. The foramen spinosum; the small irregular opening between 17 and 12 is the hiatus Fallopii. 18. The posterior fossa of the base of the skull. 19, 19. The groove for the lateral sinus. 20. The ridge upon the occipital bone, which gives attachment to the falx cerebelli. 21. The foramen magnum. 22. The meatus auditorius internus. 23. The jugular foramen.

like triangular pyramids. Two of their sides are in the cavity of the cranium; one, which is anterior, forms a portion of the middle fossa; and the other forms a part of the posterior fossa. The edge between them is very prominent, and has the tentorium or horizontal process of the dura mater attached to it. On the anterior surface, in the middle fossa, may be traced the groove, and the foramen for the Vidian nerve.

The posterior fossæ are larger as well as deeper than the other two. Their boundaries are well defined by the edges of the petrous bones above mentioned, and by the grooves of the horizontal parts of the lateral sinuses. These fossæ are nearly separated from the general cavity by the tentorium, which is attached to the edge of the petrous bone and also to the edge of the horizontal part of the groove for the lateral sinuses. On the tentorium lie the posterior lobes of the cerebrum; and under it, in these fossæ, is the cerebellum.

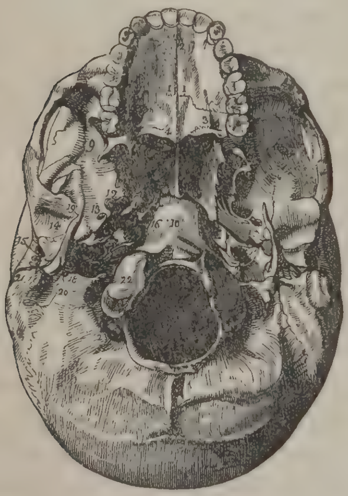
These fossæ may be considered as one great cavity, which is circular behind, and somewhat angular before. The angular surfaces are formed by the posterior sides of the petrous portions. Between them, is the oblique surface of the cuneiform process of the occipital bone, which descends to the great foramen. On the surface of each petrous bone is the meatus auditorius internus, and the orifice of the aqueduct of the vestibule. Behind the petrous portion, the groove for the lateral sinus is very conspicuous; it terminates in the posterior foramen lacerum, which is evidently formed by the temporal and the occipital bones. At the anterior part of this foramen is most commonly a small bony process, which separates the eighth pair of nerves from the internal jugular vein, as they pass out here.

The anterior condyloid foramen for the passage of the ninth pair of nerves, appears in the surface of the great occipital hole, immediately below the foramen lacerum. From the back part of this hole the spine, which forms the lower limb of the cross, passes up; and on each side of it are the great depressions which accommodate the two lobes of the cerebellum.

External Basis of the Skull.

The *external surface* of the base of the skull is very irregular. When the head is inverted, we see the external protuberances of the os occipitis, formerly described. The mastoid processes of the ossa temporum are on the same transverse line with the great foramen of the os occipitis; but the foramen being larger extends farther forward. On the inside of the mastoid process, the fissure for the digastric muscle is very conspicuous, and also the suture between the mastoid process and the occipital bone.

Fig. 30.*



The oblique direction of the occipital condyles and the slanting position of their articulating surfaces are particularly striking. The posterior condyloid foramina for the cervical veins, and the anterior for the ninth pair of nerves, are also in view. The position of the cuneiform process of the os occipitis is by no means horizontal, but extends forwards and upwards. The *petrous* or *pyramidal portion* of the temporal bone commences between the mastoid process and the condyle of the lower jaw, and extends *obliquely forwards* and *inwards*, having the

* The external or basilar surface of the base of the skull. 1, 1. The hard palate. The figures are placed upon the palate processes of the superior maxillary bones. 2. The incisive, or anterior palatine foramen. 3. The palate process of the palate bone. The large opening near the figure is the posterior palatine foramen. 4. The palate spine; the curved line upon which the number rests, is the transverse ridge. 5. The vomer, dividing the openings of the posterior nares. 6. The internal pterygoid process. 7. The scaphoid fossa. 8. The external pterygoid plate. The interval between 6 and 8 (left side of the figure), is the pterygoid process. 9. The zygomatic fossa. 10. The basilar process of the occipital bone. 11. The foramen

occipital bone behind it, and the glenoid cavity or fossæ and the os sphenoides before it. At the commencement, the surface of the petrous portion is not horizontal, but oblique, sloping into the glenoid cavity with a sharp edge downwards. This edge in some cases is curved so as to surround the basis of the styloid process, which arises in contact with it, and projects downwards, on each side of the vertebræ. Between the mastoid and styloid process, is the foramen stylo-mastoideum. On the inside of the styloid process, and rather anterior to it, is the foramen lacerum posterius, for the internal jugular vein, the eighth pair of nerves, &c. This foramen passes obliquely backwards and upwards, and is bounded behind by the jugular process of the os occipitis, which bone seems to contribute most to its formation. Very near to this hole on the inside is the anterior condyloid foramen; and rather anterior to it is the opening of the carotid canal, which forms a curve in the bone as it passes upwards, inwards, and forwards.

From the foramen lacerum posterius, the suture between the cuneiform process of the occipital and the petrous portion of the temporal bone, extends to the foramen lacerum anterius of the base of the cranium; which is closed by cartilage in the recent subject, but is of an irregular and rather triangular form in the macerated head; this hole is formed by the occipital, sphenoidal, and petrous bones. The suture or connexion between the petrous bone and the os sphenoides, is continued on the anterior side of the petrous bone, from the fissure of the glenoid cavity to the anterior foramen lacerum. The styloid process of the os sphenoides, which is seldom more than four lines in length, appears at the edge of this suture. On the inside of the glenoid cavity, and on the inside of this

magnum. 12. The foramen ovale. 13. The foramen spinale. 14. The glenoid fossa. 15. The meatus auditorius externus. 16. The foramen lacerum basis cranii. 17. The carotid foramen of the left side. 18. The foramen lacerum posterius, or jugular foramen. 19. The styloid process. 20. The stylo-mastoid forámen. 21. The mastoid process. 22. One of the condyles of the occipital bone. 23. The posterior condyloid foramen.

process, in the suture formed between the petrous and sphenoid bones, is the bony orifice of the *Eustachian* tube.

The foramen spinale, for the middle artery of the dura mater, is at a very small distance from the Eustachian tube, immediately anterior to it; and at a small distance on the inside and front of this foramen is the foramen ovale, for the inferior maxillary nerve, or the third branch of the fifth pair. —Proceeding from before backwards the base of the skull appertaining to the face is seen to be formed by the palate processes of the superior maxillary and palate bones; by the vomer; the pterygoid spinous processes, and part of the body of the sphenoid.

—The roof of the mouth as seen at 1, 3, Fig. 30, is constituted by the palatine processes of the superior maxillary and palate bones. The transverse suture which separates them is well seen on the left side of the cut. In the longitudinal suture and directly behind the front incisor teeth, 2, is the *incisive* or *anterior palatine foramen*, the inferior opening of the naso-palatine canal, which lodges the *ganglion of Cloquet* (*naso-palatine*) and transmits the anterior palatine nerves. The *posterior palatine foramina*, are placed near the posterior angles of the hard palate, for the purpose of transmitting to the palate the blood-vessels and nerves of that name. The opening of the larger foramen is seen near 3, Fig. 30. On the inner side of this foramen is seen the transverse ridge upon which is inserted the expanded tendon of the tensor palati muscle. The rounded crescentic border, which terminates posteriorly each half of the hard palate, gives attachment to the velum pendulum palati; and in the middle line 4, is seen the palate spine from which is hung the azygos uvulœ muscle. The posterior nares is seen immediately above divided by the vomer, 5, and bounded externally by the internal pterygoid processes, 6. By the side of the shelving base of the vomer and partly formed by it are the pterygo-palatine canals, which transmit the pterygo-palatine arteries. The external pterygoid process is seen at 8, and between the two processes, is the pterygoid fossa, which is occupied by the internal pterygoid muscle.

On the outer side of the external pterygoid process is the zygomatic fossa. The internal pterygoid process is long and narrow, having at its apex the hamulus, and at its base the scaphoid fossa from which arises the circumflexus or tensor palati muscle.—

Side of the Head.

Those portions of the side of the head which are formed by the frontal, parietal and occipital bones, and by the squamous part of the temporal, require no explanation here; but the *region* which is behind the *malar* and *upper maxillary* bone, and within the *zygomatic processes* of the *temporal* and *malar* bones, which comprises part of the temporal and zygomatic fossæ of some anatomists, is both important and obscure.

To obtain a view of this, the lower jaw should be removed, and the zygoma sawed away, in one preparation; and in another, the upper maxillary and palate bones of one side should be applied in their natural position, to the os sphenoides, without any of the other bones.

The upper part of this region, formed by the sphenoidal, frontal and malar bones, is made concave by the form of the external angular part of the os frontis and of the os malæ; which projects backwards so as to cover a large portion of it.

The lower part is formed principally by the external surface of the pterygoid process of the sphenoid bone, and by the posterior surface of the upper maxillary. Between the lower end of the pterygoid process and the upper maxillary bone, a small portion of the os palati intervenes; but in many adult subjects it is not to be distinguished from the other bones. At this place, the pterygoid process and these bones appear to be in close contact; but as they pass upwards they recede from each other so as to form a considerable aperture, which continues the whole length of the pterygoid process. This *fissure*, which may be called *pterygo-palatine* or *pterygo-maxillary*, would open into the posterior part of the cavity of the nose, if the nasal plate of the os palati did not intervene;

this plate forms a partition, which separates the nose from this fissure: and the spheno-palatine foramen, formed principally by it, transmits a nerve and blood-vessels to the nose.

The fissure is vertical: at the back of the orbit, it unites with the spheno-maxillary fissure of the orbit, which is almost horizontal, and at the place of their junction, the sphenoidal, or upper fissure of the orbit, opens also.

The foramen rotundum, which transmits the second branch of the fifth pair, or the upper maxillary nerve, is likewise situated near this place; and when the upper maxillary, the sphenoidal, and the palate bones are in their natural situation, the distribution of the branches of this important nerve can be easily understood: for the same view presents the course of its various branches; viz. to the nose, by the spheno-palatine foramen; to the cavity of the cranium, by the pterygoid foramen; to the orbit, and the inferior obitary canal, by the spheno-maxillary fissure; and to the roof of the mouth, by the palato-maxillary canal.

The Form of the Cranium.

The *form* of the *cranium* is that of an irregular oval. The *greatest length* of its cavity is between a part of the os frontis above the crista galli, and of the os occipitis above the centre of the crucial ridge.

The *greatest breadth* is at about two-thirds of the distance from the first to the last of these positions. This transverse diameter touches the sides of the cranium near the posterior part of the basis of the petrous portion of the temporal bone. The difference between these longitudinal and transverse diameters varies greatly in different persons, as their craniums approach to the oval or round figures.

The *greatest depth* of the cavity is between the posterior part of the cuneiform process of the occipital bone, and a part of the cranium which is nearly over it about the middle of the sagittal suture.

The figure of the cranium is somewhat varied in different

races of men; and it has been much changed by the particular management of several savage nations.

In North America, the Choctaw tribe of Indians were formerly accustomed to make their foreheads perfectly flat, and sloping obliquely backwards. They have latterly disused this practice; but one of their nation, whose head had this form, was in Philadelphia about the year 1796.

At this time a tribe who inhabit a district of country near the sources of the Missouri river, are in the practice of flattening both the frontal and occipital regions of the head; so that a small part only, of the middle of it, remains of the natural form, between these flattened sloping surfaces.

In the case of the Choctaw man above-mentioned, it did not appear that his health, or his intellectual operations, were any way affected by this form of his head.

During infancy, the cranium sometimes increases to a preternatural size, as disproportionate to the face as if it were affected by hydrocephalus. In many of these instances, that disease ultimately shows itself; but in other cases, the preternatural increase of the cranium finally stops without the occurrence of disease; and the disproportion is lessened by the increase of the face in the ordinary progress of growth.

In many cases where men have deviated from the ordinary stature, the head has preserved the common size. It is therefore said to be small in giants, and large in dwarfs.

—Many efforts have been made to determine rigorously the dimensions of the cavity of the cranium. This may be done with considerable accuracy from the exterior of the skull, by making allowances for the various degrees of developement in which the frontal sinuses are found in different individuals. The thickness of the diploe seldom varies in different skulls more than one or two lines in thickness. I have, however, several negro skulls in my possession the walls of which are nearly three-quarters of an inch in thickness, and so compact in their composition as to present very little of the diploic or cellular structure. When measured from the interior, a skull of ordinary capacity will be found in its

longitudinal diameter, (between the frontal spine and longitudinal sulcus,) five inches and a half; in its transverse, (between the bases of the petrous portions of the temporal bones,) four and a half; between the parietal fossæ five inches, and between the lesser wings of the sphenoid bones, three inches and three-quarters; in the vertical, from the foramen magnum to the sagittal suture, four inches and a half.

—Several plans have also been adopted, by the cranioscopists, to determine the relative developement of the cranium (which is filled with the brain) and that of the face. The best known of these are those of Camper, Daubenton and Cuvier. The facial angle of Camper, is taken by extending a horizontal line from the external auditory meatus, on a line with the floor of the nostrils, so as to follow nearly in the direction of the base of the cranium, and by dropping upon this a second from the most prominent part of the forehead to the extremity of the upper jaw. The area between them is the facial angle, and will be the more acute, in direct proportion as the face is developed in front, and the forehead is sloped backwards. This angle is of course larger in man than in any other animal, and varies in size in the different races of men. In a well formed white or Caucasian, it is usually about 80°; in the Mongolian about 75°; in Negroes acout 70°; in the different species of monkeys it varies from 65° to 30°. As a test of the intellectual capacity of individuals, it is but little to be relied on.

—The occipital angle of Daubenton, is formed by drawing two lines, one from the inferior border of the orbit, to the anterior margin of the occipital foramen, the other drawn from the anterior to the posterior border of the occipital foramen, and extended forwards. The angle between the two, is the occipital. As the direction of the occipital foramen depends upon the manner in which the head is articulated with the vertebral column, it will be the larger, the less favourably the animal is constructed for the upright posture. In a well-formed Caucasian skull, it is about 3°. In the ox it is about 70°. Daubenton has thus done for the posterior part of the head what Camper has done for the anterior.

—Cuvier's method consists in dividing the skull vertically, and establishing a comparison between the area of the cranium and that of the face. In a well-formed Caucasian he finds the area of the cranium, quadruple that of the face. In the Mongolian variety, he found the area of the face had increased over this proportion one-tenth, in the Negro, one-fifth; in monkeys, one-half. Tiedemann has adopted a plan of measuring the capacities of different crania, by filling them with seeds from the occipital foramen, and subsequently measuring their contents. This method as well as some others, has been employed for the same purpose by Prof. S. G. Morton of this city, in his elegant and interesting work on *Crania Americana*, and the results have been so carefully detailed by him, as to leave henceforth little to be wished upon a subject which has excited much attention among physiologists. The whole capacity of the cranium is found on an average, greater in the Caucasian variety of the human race, than in any other.

The Head of the Fœtus.

In the fœtus, those bones, which form the vault of the cranium, *originally* consist of one plate only; which is composed of radiant fibres.

At birth, the *os frontis* consists of two pieces, which join each other in the middle of the forehead.

The *parietal bones* are each in a single piece; but they are incomplete at their edges and their angles.

The *temporal bones* have no appearance of mastoid or styloid processes. Instead of a meatus auditorius externus, there is a bony ring in which the membrana tympani is fixed. The squamous and petrous portions, and this ring, are originally formed separate; but at the period of birth they often adhere to each other.

The *os occipitis* is composed of four pieces: the first and largest, extends from the beginning or angle of the lambdoidal suture to the upper edge of the great occipital foramen. Each side of the foramen, and the condyle on it, is formed by a distinct piece. The front part is formed by the cuneiform

process, which is separate from the other parts and forms the fourth piece.

The *sphenoidal bone* may be separated by maceration into three pieces. The body and the little wings form one piece. Each of the great wings, with the pterygoid processes united to it, forms also a piece. The body of the bone is entirely solid.

A large part of the *ethmoid* is in a cartilaginous state. It is divided into two portions by a partition of cartilage, which occupies the place of the nasal plate and the crista galli.

In consequence of the imperfect formation of the bones which compose the vault of the cranium, there are several deficiencies in it. Thus the superior anterior angles of the parietal bones being incomplete, and also the upper angles of the pieces which compose the os frontis, a vacuity with four sides is occasioned, which is termed the

Anterior fontanel. This opening may be distinguished by its form, as well as its greater size, from another vacuity which is produced in a similar way at the other end of the sagittal suture, and called the

Posterior fontanel: but as there are only three bones concerned in its formation, viz. the two parietal and the occipital, this vacuity is triangular.

Besides these, there are two other *vacuities* or *fontanels* on each side, at the two lower corners of each parietal bone: these, however, are much less than those first described.

The *smaller fontanels* do not continue open long; but the anterior fontanel is seldom completely closed before the end of the third year.

It is very obvious upon an examination of the cranium, that the centre of the base is better calculated to resist pressure than any other part; as the cuneiform process of the occipital bone, the petrous portion of the temporal, and the body of the sphenoidal bone, which compose a large part of it, are very firm and substantial.

The *face of the fœtus* differs very essentially from that of the adult. Although the orbits of the eyes are very large when

compared with the size of the head, that portion of the face which is below them is very small, and has little depth.

The upper maxillary bones have no sinuses in them; and their orbitar plates are not much elevated above the cavities for containing the posterior teeth; in consequence, the depth of the face is very small, and its whole aspect is affected.

The *nose* of the *fœtus* differs greatly from that of the adult in respect to its sinuses; for not only are the maxillary cavities wanting, but those of the frontal and sphenoidal bones also.

The *lower jaw* is formed in two pieces, which unite at the middle; and hence the term *symphysis* is used in describing the chin. The bone is not only less broad in proportion than that of the adult, but the angles are more obtuse, and the processes which arise from them are more sloping.

The head of the fœtus is much larger in proportion to the body than that of the adult.

Of the Trunk.

The *Trunk* consists of the Spine, Thorax, and Pelvis.

The Spine.

The *spine* is the long pile of bones extending from the condyles of the occiput to the end of the os coccygis. It somewhat resembles two unequal pyramids joined in a common base. It is not, however, straight; for its upper part being drawn backwards by strong muscles, it gradually advances forwards to support the œsophagus, vessels of the head, &c. Then it turns backwards, to make room for the heart and lungs. It is next bent forwards to support the viscera of the abdomen. It afterwards turns backwards for the enlargement of the pelvis. And, lastly, it is reflected forwards, for sustaining the lowest great intestines.

The spine is commonly divided into *true* and *false vertebræ;* the former constituting the long upper pyramid, which has its base below; while the false vertebræ make the shorter lower pyramid, whose base is above.

True Vertebræ.

Fig. 31.*

The *true vertebræ* are the twenty-four upper bones of the spine, on which the several motions of the trunk of our bodies are performed. Their name is derived from the Latin verb *vertere.*

Each of these vertebræ is composed of its body and processes.

The *body* is the thick spongy forepart, which is convex before, concave backwards, horizontal and flat in most of them above and below. Numerous small holes, especially on the fore and back part of their surface, giving passage to their vessels, and allow the ligaments to enter their substance. The edges of the body of each vertebræ are covered, especially at the forepart, with a ring of bone firmer and more solid than the substance of the body any where else. These rings seem to be joined to the vertebræ in the form of epiphysis. They are of great use in preventing the spongy bodies from being broken in the motions of the trunk.

Between the bodies of each two adjoining vertebræ, a substance between the nature of ligament and cartilage is interposed; which seems to consist of concentrical curved fibres, when it is cut horizontally; but when it is divided perpendicularly, the fibres appear

* The vertebral column—consisting of twenty-four true vertebræ; and two false, the sacrum and os coccygis, each made up by the consolidation of four bones which are separate in the young subject.—It extends the whole length of the trunk.—It may be divided into four regions—the *cervical* comprising the seven vertebræ from *a* to *b*.—The *dorsal*, the twelve vertebræ from *b* to *c*.—The *lumbar*, the five vertrebræ from *c* to *d*.—The *pelvic* or *sacro-coccygeal* portion comprising the false vertebræ, the sacrum and coccyx from *d* to *f*.—From *e* to *f*. are the four small bones forming the os coccygis.

oblique and decussating. The outer part of these intervertebral ligaments is the most solid and hard; and they gradually become softer till they are almost in the form of a glairy liquor in the centre. The external fibrous part of each is capable of being greatly extended, and of being compressed into a smaller space, while the middle fluid part is incompressible, or nearly so. The middle point is therefore a fulcrum or pivot, on which the motion of a ball and socket may be made, with such a gradual yielding of the substance of the ligament, in whatever direction our spines are moved, as saves the body from violent shocks, and their dangerous consequences. This ligamento-cartilaginous substance is firmly fixed to the horizontal surfaces of the bodies of the vertebræ, to connect them; in which it is assisted by a strong membranous ligament, which lines all their concave surface, and by a still stronger ligament that covers all their anterior convex surface.

The elastic substance seems to be in a state of compression by the exterior ligament and the bones; for, if a section be made through a portion of the vertebræ and the intervertebral substance, this substance will expand, so that its surface will be much higher than that of the vertebræ. It is so elastic, and so much confined, in some subjects, that a sharp knife, if plunged into it will be gradually ejected when the hand is withdrawn.

The bodies of the vertebræ are, with some exceptions, smaller and more solid above, but more spongy as they descend. The cartilages between them are thick, and the surrounding ligaments are strong in proportion to the size of the vertebræ. By this disposition, the greatest weight is supported on the broadest, best secured base, and the middle of the body is allowed a large and secure motion.

From each side of the body of each vertebræ, a bony bridge or pedicle is produced backwards, and to one side; from the posterior end of which one slanting process rises, and another descends. The smooth, and generally the flattest side of each of these four processes is covered with a smooth cartilage; and the two lower processes of each upper vertebræ are fitted to

and articulated with the two upper processes of the vertebræ below, having their articular ligaments fixed into the rough line round their edges. These processes are termed the *oblique* or *articulating*.

From between the oblique processes of each side, another process extends laterally, which is called the *transverse*.

From the back part of the roots of the two oblique processes, and of the transverse process of each side, a broad oblique bony plate called the *lamella* is extended backwards: where these meet, the seventh process of the vertebræ takes its rise, and stands out backwards. This being generally sharp-pointed and narrow-edged, it has therefore been called *spinous* process; from which this whole chain of of bones has got its name.

Besides the common ligament which lines all the internal surface of the spinous processes as well as of the bodies, particular ligaments connect the bony bridges and processes of the contiguous vertebræ together.

The substance of the processes is considerably stronger and firmer, and has a thicker external plate than the bodies of the vertebræ themselves.

The seven *processes* form a concavity at their forepart, which, joined to the one at the back part of the bodies, make a great hole; and when the vertebræ are placed upon each other in their natural order, these holes form a long tube for containing the spinal marrow.

In the upper and lower edge of each lateral bridge or pedicle, there is a notch. These are so adapted to each other in the contiguous vertebræ, as to form a round hole in each side, between each two vertebræ, through which the nerves proceed from the spinal marrow, and its blood-vessels pass.

The *articulations* of each two vertebræ are consequently double; for their bodies are joined by the intervening cartilage above described; and their oblique processes, being tipped with cartilages, are connected together by ligaments so as to allow a small degree of motion on every side. Hence, it is evident that their centre of motion is altered in different positions of

the trunk: for, when we bow forwards, the weight bears entirely on the bodies of the vertebræ; if we bend back, the oblique processes support it; if we recline to one side, we rest upon the oblique processes of that side and part of the bodies; if we stand erect all the bodies and oblique processes have their share in our support.

The *true vertebræ* are divided into three *classes*, which agree with each other in their general structure, but are distinguished by several peculiarities.

These classes are named *Cervical*, *Dorsal*, and *Lumbar*.

The CERVICAL are the seven uppermost vertebræ; which are distinguished from the rest by these marks: their bodies are smaller and more solid than any others; and are flattened on the front surface. They are also flat behind, where small processes rise, to which the internal ligaments are fixed. The upper surface of the body of each vertebræ is made hollow, by a slanting thin process which is raised on each side. The lower surface is also hollowed, but in a different manner; for here the posterior edge is raised a little, and the anterior one is considerably extended. Hence, the cartilages between these vertebræ are firmly connected, and their articulations are secure.

Fig. 32.*

These cartilages are thick, especially at their forepart; which is one reason why the vertebræ project forward as they descend, and have the larger motion.

Their *oblique* processes more justly deserve that name than those of any other vertebræ. They are situated slanting; the upper ones having their smooth and almost flat surfaces facing obliquely backwards

* A central cervical vertebræ, seen upon its upper surface. 1. The body concave in its middle, and rising on each side into a slanting thin process or ridge. 2. The lamina or lamella. 3. The pedicle rendered concave by the superior intervertebral notch. 4. The bifid spinous process. 5. The bifid or notched transverse process. 6. The vertebral foramen. 7. The superior oblique or articular process. 8. The inferior oblique or articular process.

and upwards; while the inferior oblique processes have these surfaces facing obliquely forwards and downwards.

The *transverse* processes of these vertebræ are formed in a different manner from those of any other bones of the spine; for, besides the common transverse process rising from between the oblique processes of each side, there is a second one that comes out from the side of the body of each vertebræ; and these two processes, after leaving a circular hole for the passage of the vertebral artery and vein, unite and form a groove on their upper surface to protect the nerves that pass in it. They terminate obtusely on each side, for the insertion of the muscles.

The *spinous* processes project backwards almost horizontally. They are shorter than those of any other vertebræ, and are forked or double at their ends; they therefore allow a more convenient insertion to muscles.

The thick *cartilages* between the bodies of these cervical vertebræ, the obliquity of their oblique processes, and the shortness and horizontal situation of their spinous processes, all conspire to allow them large motion.

The *holes* between the bony cross bridges, for the passage of the nerves from the spinal marrow, have their largest share formed in the lowest of the two vertebræ, to which they are common.

So far most of the cervical vertebræ agree; but they have some particular differences, which require a separate consideration.

The first, from its use in supporting the head, has the name of *atlas*. Contrary to all the other vertebræ of the spine, it has no body; but, instead of it, there is a bony arch. In the convex forepart of this arch a small rising appears; and on each side of this protuberance, a small cavity may be observed. The upper and lower parts of the arch are rough and unequal, where the ligaments that connect this vertebra to the os occipitis, and to the second vertebra, are fixed. The back part of the arch is concave, smooth, and covered with a cartilage, in a recent subject, to receive the tooth-like process of the second

vertebra. On each side of it a small rough sinuosity may be remarked, where the ligaments going to the sides of the tooth-like process of the following vertebra are fastened; and on each side a small rough protuberance and a depression is observable, where the transverse ligament, which secures the tooth-like process in the sinuosity, is fixed, and hinders that process from injuring the medulla spinalis in the flexions of the head.

The atlas has as little spinous process as body; but, instead of it, there is a large bony arch, that the muscles which pass over this vertebra at that place might not be hurt in extending the head. On the posterior and upper part of this arch, there are two depressions, where the recti postici minores muscles take their rise; and at the lower part are two other sinuosities, into which the ligaments that connect this bone to the following one are fixed.

The superior oblique processes, of the atlas are large, and more horizontal than those of any other vertebra. They form an oblong concave surface which has an internal aspect, and corresponds exactly with the articulating surface on the external side of each condyle of the os occipitis. Under the external edge of the posterior part of each of these cavities is the fossa, or deep open channel, in which the vertebral arteries make the circular turn, as they are about to enter the great foramen of the occipital bone, and where the tenth pair of nerves go out. In some subjects, this fossa is covered with bone. The inferior oblique processes, extending from within outwards and downwards, are large, circular, and slightly concave. So that this vertebra, contrary to the other six, receives the bones with which it is articulated, both above and below.

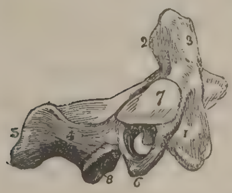
The transverse processes of this vertebra are not much hollowed or forked; but are longer and larger than those of any other vertebræ of the neck, for the origin and insertion of several muscles; and, therefore, those muscles which move this vertebra on the second, have a considerable lever to act with, because of the distance of their insertion from the axis of revolution.

The hole for the medulla spinalis is larger in the atlas than

in any other vertebra, not only on account of the medulla being largest here, but also to prevent its being hurt by the motions of this vertebra on the second. This large hole, and the long transverse processes, make this the broadest vertebra of the neck. The condyles of the os occipitis move forwards and backwards in the superior oblique processes of this vertebra; but from the figure of the bones forming these articulations, it is evident that very little motion can here be allowed to either side; and there must be still less circular motion.

The second vertebra of the neck is called *dentata*. It is somewhat of a pyramidal figure, being large, and extended downwards, especially in front, to enter into a hollow of the vertebra below; while the upper part has a long process, with its extremity formed into an obtuse point. This process, from its supposed resemblance to a tooth, has given name to the vertebra. The side of it, on which the concave surface of the anterior arch of the first vertebra plays, is convex, smooth, and covered with a cartilage; and it is of the same form behind, to accommodate the ligament which is extended transversely from one rough protuberance of the first vertebra to the other, and is cartilaginous in the middle. A ligament likewise goes out in an oblique transverse direction, from each side of the processus dentatus, to be fixed at its other end to the first vertebra, and to the occipital bone; and another ligament rises up from near the point of the process to the os occipitis.

Fig. 33.*



The superior oblique processes of the vertebra dentata are large, circular, very nearly in a horizontal position, and slightly convex, to be adapted to the inferior oblique processes of the first

* A lateral view of the axis or vertebra dentata. 1. The body. 2. The dentated or odontoid process. 3. The smooth surface on the anterior face of the tooth-like or dentated process, which articulates with the posterior face of the anterior arch of the atlas. 4. The lamina. 5. The spinous process. 6. The transverse process pierced obliquely by the foramen for the vertebral artery. 7. The superior oblique or articular process. 8. The inferior articular process.

vertebra. The inferior oblique processes of this vertebra answer exactly to the description given of those common to all the cervical vertebræ.

The transverse processes of the vertebra dentata are short, very little hollowed at their upper part, and not forked at their ends; and the canals through which the vertebral arteries pass, are reflected outwards about the middle of each process, so that the course of these vessels may be directed towards the transverse processes of the first vertebra. Had this curvature of the arteries been made in a part so movable as the neck is, while they were not defended by a bone and placed in the cavity of that bone, scarce a motion could have been performed without the utmost hazard of compression. This is the third instance of similar mechanism in cases of sudden curvature of arteries. The first is the passage of the carotids through the temporal bones; and the second is that lately described, where the vertebral arteries turn round the oblique processes of the first vertebra, to come at the great hole of the occipital bone.

The spinous process of this vertebra is thick, strong, and short, to give sufficient origin to the musculi recti majores and obliqui inferiores, and to prevent the contusion of these and other muscles in pulling the head back.

The four cervical vertebræ which are next in order have nothing particular in their structure, but agree with the general description. The seventh vertebra approaches the form of those of the back, having the upper and lower surfaces less excavated than the others. The oblique processes are more perpendicular; and the spinous as well as transverse processes are without bifurcation.

After an examination of the condyles of the os occipitis, and of the whole structure of the atlas and vertebra dentata, it will be evident, that the flexion and extension of the head, or its motion backwards and forwards, is effected by the movements of the condyles of the occipital bone on the atlas; and that in the rotation of the head, the atlas revolves to a certain degree round the processus dentatus of the second vertebra: the head necessarily moving with it.

The TWELVE DORSAL may be distinguished from the other *vertebræ* of the spine by the following marks.

Their bodies are of a middle size, between those of the neck and loins. They are more convex before than either of the other two sorts; and are flattened laterally by the pressure of the ribs, which are inserted into small cavities formed in their sides. This flatness of their sides, which makes the figure of these vertebræ almost a half oval, is of great use; as it affords a firm articulation to the ribs, allows the tracheal tube to divide at a small angle, and the other large vessels to run secure from the action of the vital organs. Their bodies are more concave behind than any of the other two classes. The upper and lower surfaces are horizontal.

The cartilages interposed between the bodies of these vertebræ are thinner than in any other of the true vertebræ; and contribute to the concavity of the spine in the thorax, by being thinnest in their forepart.

The oblique processes are placed almost perpendicularly: the upper ones slanting but a little forwards, and the lower ones slanting as much backwards. The convexity or concavity is not so remarkable as to require particular notice. Between the oblique processes of opposite sides several sharp processes stand out from the upper and lower parts of the plates which join to form the spinous processes: into these sharp processes strong ligaments are fixed for connecting the vertebræ.

The transverse processes of the dorsal vertebræ are long, thicker at their ends than in the middle, and turned obliquely backwards, which may be owing to the pressure of the ribs; the tubercles of which are inserted into a depression near the end of these processes.

The spinous processes are long, small-pointed, and sloping downwards and backwards. From their upper and back part a ridge rises, which is received by a small channel in the forepart of the spinous process immediately above, which is here connected to it by a ligament.

The canal for the spinal marrow is here more circular, but corresponding to the size of that chord, is smaller than in any

of the other vertebræ; and a larger share of the holes in the bony bridges for the transmission of the nerves, is formed in the vertebra above than in the one below.

Fig. 34.*

The connexion of the dorsal vertebræ to the ribs, the thinness of their cartilages, the erect situation of the oblique processes, the length, sloping, and connexion of the spinous processes, all contributing to restrain these vertebræ from much motion, which might disturb the actions of the heart and lungs; and in consequence of the little motion allowed here, the intervertebral cartilages sooner shrivel, by becoming more solid; and therefore the first remarkable curvature of the spine observed, as people advance to old age, is in the least stretched vertebræ of the back; or old people first become round-shouldered.

The bodies of the four uppermost dorsal vertebræ deviate from the rule, that the vertebræ become larger as they descend; for the first of the four is the largest, and the other three below gradually become smaller, to allow the trachea and large vessels to divide at smaller angles.

The two uppermost vertebræ of the back, instead of being very prominent forwards, are flattened by the action of the musculi longi colli and recti majores.

The proportional size of the two little depressions in the body of each vertebra for receiving the heads of the ribs seems to vary in the following manner: the depression on the upper edge of each vertebra decreases as far down as the fourth, and, after that, increases.

* A lateral view of a dorsal vertebra. 1. The body. 2. 2. Articular facets for the head of the ribs. 3. The pedicle. 4. The superior intervertebral notch. 5. The inferior intervertebral notch. 6. The spinous process. 7. The extremity of the transverse process marked by an articular surface for the tubercle of the rib. 8. The two superior oblique processes looking backwards. 9. The two inferior oblique processes looking forwards.

The transverse processes are longer in each lower vertebra to the seventh or eighth, with their smooth surfaces, for the tubercles of the ribs, facing gradually more downwards; but afterwards, as they descend, they become shorter, and the smooth surfaces are directed more upwards.

The spinous processes of the vertebræ of the back become gradually longer and more slanting from the first, as far down as the eighth or ninth vertebra; from which they manifestly turn shorter and more erect.

The first vertebra, besides an oblong hollow in its lower edge that assists in forming the cavity wherein the second rib is received, has the whole cavity for the head of the first rib formed in it.

The eleventh often has the whole cavity for the eleventh rib in its body, and wants the smooth surface on each transverse process.

The twelfth always receives the whole head of the last rib, and has no smooth surface on its transverse processes, which are very short. The smooth surfaces of its inferior oblique processes face outwards as the lumbar do. In general the upper vertebræ of the back lose gradually their resemblance to those of the neck, and the lower ones approach gradually to the figure of the lumbar.

Fig. 35.*

The LUMBAR VERTEBRÆ are five bones, that may be distinguished from any others by these marks: 1. Their bodies, though of a circular form at their forepart, are somewhat oblong from one side to the other. The epiphysis on their edges are larger; and therefore the upper and lower surfaces of their bodies are more concave than in the vertebræ of the back.

* A lateral view of the lumbar vertebra. 1. The body. 2. The pedicle. 3. The superior intervertebral notch. 4. The inferior intervertebral notch. 5. The spinous process. 6. The transverse process. 7. The superior articular processes. 8. The inferior articular processes.

The pedicles are very strong, the lamella or laminæ, see page 139, are thick and narrow. 2. The cartilages between these vertebræ are very thick, and render the spine convex within the abdomen, by their great thickness anteriorly. 3. The oblique processes are strong and deep; the superior, which are concave, facing inwards, and the convex inferior ones facing outwards; and therefore each of these vertebræ receives the one above it, and it is received by the one below, which is not so evident in the other two classes already described. 4. Their transverse processes are small, long, and almost horizontal, for allowing large motion to each bone, and sufficient insertion to muscles, and for supporting and defending the internal parts. 5. Between the roots of the superior oblique and transverse processes, a small protuberance may be observed, where some of the muscles that raise the trunk of the body are inserted. 6. Their spinous processes are strong, straight, and horizontal, with broad flat sides, and a narrow edge above and below; this last being depressed on each side, by muscles; and, at the root of these edges, we see rough surfaces for fixing the ligaments. 7. The medullary canal is larger in these bones than in the dorsal vertebræ. 8. The holes for the passage of the nerves are more equally formed out of both the contiguous vertebræ than in the other classes; the upper one furnishes, however, the larger share of each hole.

The thick cartilages between these lumbar vertebræ, their deep oblique processes, and their erect spinous processes, are all fit for allowing large motion, though it is not so great as what is performed in the neck; which appears from comparing the arches that the head describes when moving on the neck or the loins only.

The lumbar vertebræ, as they descend, have their oblique processes at a great distance from each other, and facing more backward and forwards.

The transverse and spinal processes of the first and last lumbar vertebræ are shorter than those in the middle.

The epiphyses round the edges of the bodies of the lumbar vertebræ are most raised in the two lowest; which conse-

quently make them appear hollower in the middle than the others are.

The body of the fifth vertebra is rather thinner than that of the fourth. The spinous process of this fifth is smaller, and the oblique processes face more backwards and forwards, than those of any other lumbar vertebræ.

In consequence of this particular construction, the spine is capable of flexion, principally in an interior and lateral direction, and also of extension. It ought to be remarked, that during flexion it forms a curve, and not an angle; for, in the last case, the spinal marrow would be more or less compressed.

The cervical vertebræ have most motion, and the dorsal the least. This circumstance is fully explained by the form of the different parts of these vertebræ, and the difference in the thickness of the intervertebral substance. The necessity of fixing the dorsal vertebræ is very evident: as their motion would greatly interfere with the motion of the ribs in respiration.

The lumbar vertebræ have more motion than is commonly supposed; for, in addition to a certain degree of flexion, they perform a species of rotation or twisting, which is very observable in persons who are diseased in one of their hip joints; such persons move their whole pelvis, by a rotation of the lumbar vertebræ, to avoid moving the diseased joint.

—The first cause, the predisposing cause of spinal curvatures is the relative feebleness of the spinal column, compared to the forces exercised upon it, at the same time that the bones, by a premature increase, or by a lesion of nutrition as yet little known, do not acquire the degree of solidity necessary to resist the action of the muscles, and especially the weight of the viscera contained in the head, chest, &c. There results from this necessarily a curvature in one of the points of the lever, and in some one direction.

—The direction of the curvature will be determined by the inequality of the forces brought into play around it. For without this inequality, the curvature would be direct; that is, straight. It is ordinarily to the left that it has place, because

the muscles of the right side, stronger than those of the left, draw the vertebra in that direction, as Ludwig pointed out.—

False Vertebræ.

The lower pyramid or under part of the spine, consists of one large triangular bone, called the *os sacrum,* and of some small bones, denominated the *os coccygis.*

These bones are called the false vertebræ, because the *sacrum* in young subjects is composed of five distinct bones, each of which has some resemblance to a vertebra ; but they are completely united in the adult, and form but one bone, which is supposed to have been denominated sacrum, because it was offered in sacrifice by the ancients.

The *os sacrum* is of a triangular form, with its base upwards. It is concave anteriorly, and convex posteriorly. The middle of the bone, when viewed anteriorly, appears to be composed of the bodies of five vertebræ, united to each other, and their union is marked by four transverse lines. At the two extremities of each of these lines, are large round holes, which communicate with the vertebral cavity of the bone.

On the exterior sides of these holes the surface is free from any marks of the original separation.

The middle of the upper surface, or base of the bone, is formed for articulating with the last lumbar vertebra, and has two oblique processes, with a groove in each side, which forms part of the foramen for transmitting the twenty-fourth pair of nerves.

The back part of the os sacrum is rough and convex ; in the middle there are commonly three processes similar to the spinous processes of the lumbar vertebræ, and a fourth, which is much smaller. Below this, there is a deficiency of the bony spine, and the vertebral cavity is consequently open behind, but the sides of the canal continue lower down.

On each side of the spinous processes are four smaller holes, which are opposite to the larger holes on the anterior surface. Between the spinous processes and the anterior part, which

Fig. 36.*

resembles the bodies of vertebræ, is the continuation of the vertebral cavity which contains the spinal marrow. From the cauda equina, contained in this cavity, the great nerves of the lower extremities pass off, through the large holes on the anterior surface, and some small nerves through the posterior holes.

In some bones the spinous processes are entirely deficient, and the cavity above mentioned is completely open behind; but the contained parts are defended by strong membranes.

The anterior part of each lateral surface is covered by a plate of cartilage, and articulated to the os ilium. The posterior part is rough, and perforated by the fibres of the strong ligaments, which are inserted into it.

On the posterior surface of the sacrum, the sides of the open part of the vertebral canal terminate, so as to form a notch through which passes the twenty-ninth pair of nerves.

The os sacrum is very spongy, and is lighter in proportion to its bulk than any bone in the body: it is defended by the muscles that cover it, and the ligaments which adhere to it. It is articulated, above, to the last lumbar vertebra; below, to the os coccygis by its apex and two cornua; and on the sides, to the ossa ilia.

That triangular chain of bones depending from the os sacrum, in which each bone becomes smaller as it descends, till the last ends in a small tubercle, is called *os coccygis*. It is convex behind, and concave before; from which crooked

* The sacrum seen upon its anterior surface. 1, 1. The transverse lines marking the original constitution of the bone of four pieces. 2, 2. The anterior sacral foramina. 3. The promontory of the sacrum. 4. The ear-shaped surface which articulates with the ilium. 5. The sharp edge to which the sacro-ischiatic ligaments are attached. 6. The vertebral articular surface. 7. The broad triangular surface which supports the psoas muscle and lumbosacral nerve. 8. The articular process of the right side. 9. The inferior extremity, or apex of the sacrum. 10. One of the sacral cornua. 11. The notch which is converted into a foramen by the coccyx.

pyramidal figure, which was thought to resemble a cuckoo's beak, the name is derived.

There are four pieces in people of middle age. In children, they are almost wholly cartilaginous. In old subjects, all the bones are united, and become frequently one continued bone with the os sacrum.

The highest of the four bones is the largest, with shoulders extended farther to each side than the end of the os sacrum; which enlargement may serve as a distinguishing mark to fix the limits of either bone. The upper surface of this bone is a little hollow. From the back of that bulbous part called its *shoulders*, a process often rises up on each side, to join with the os sacrum. Sometimes these shoulders are joined to the sides of the open end of the vertebral canal, to form the hole in each side common to these two bones, for the passage of the twenty-ninth pair of spinal nerves. Immediately below the shoulders of the os coccygis, a notch may be remarked on each side, where the thirtieth pair of the spinal nerves passes. The lower end of this bone is formed into a small head, which very often is hollow in the middle.

The three lower bones gradually become smaller, and are spongy, but are strengthened by a strong ligament, which covers and connects them. Their ends, by which they are articulated, are formed in the same manner as those of the first bone.

Between each of these four bones of young subjects a cartilage is interposed; therefore their articulation is analogous to that of the bodies of the vertebræ of the neck; for the lower end of the os sacrum, and of each of the three superior bones of the os coccygis, has a small depression in the middle; and the upper part of all the bones of the os coccygis, is a little concave, and, consequently, the interposed cartilages are thickest in the middle, to fill up both cavities; by which they connect the bones more firmly. When the cartilages ossify, the upper end of each bone is formed into a cavity, exactly adapted to the protuberant lower end of the bone immediately above. From this sort of articulation, it is evident that, unless

when these bones grow together, all of them are capable of motion; of which the first and second enjoy the largest share.

The lower end of the fourth bone terminates in a rough point, to which a cartilage is appended.

To the sides of these bones of the os coccygis, the coccygæi muscles, and part of the levatores ani, and of the glutæi maximi, are fixed.

The connexions of these bones hinder them from being moved to either side; and their motion backwards and forwards is much confined: yet, as their ligaments can be stretched by a considerable force, it is of great advantage in the excretion of the fæces alvinæ, and much more in child-bearing, that these bones should remain movable; and the right management of them, in delivering women, is very important. The mobility of the os coccygis diminishing as people advance in age, especially when its ligaments and cartilages have not been kept flexible by being stretched, is, probably, one reason why women, who are advanced in years before they marry, have generally difficult parturition.

These bones serve to sustain the intestinum rectum; and, therefore, are curved forwards; by which they are preserved, as well as the muscles and teguments, from any injury when sitting with the body inclined back.

The Vertebral Cavity for containing the Spinal Marrow.

The canal, formed by the foramina of the different vertebræ, when these bones are placed in their natural order, extends from the great occipital foramen to the end of the sacrum. Its direction varies with the different curvatures of the spine, and its figure and diameter are also very different in different places.

In the cervical vertebræ, it is largest, and nearly triangular in form; in the dorsal, it is much smaller and almost cylindrical; in the lumbar, it is somewhat enlarged, and approaches again to the triangular figure; in the sacrum, it is broad, but flat, and diminishes gradually, so as to assume the form of a long triangle.

It has a ligamentous lining, which will be described, when an account is given of the fresh bones and their ligaments.

The Thorax.

The thorax resembles a flattened cone, cut away obliquely at its basis; and regularly truncated at its apex.

It is formed by the dorsal vertebræ behind, the ribs on the sides, and the sternum before.

The Ribs

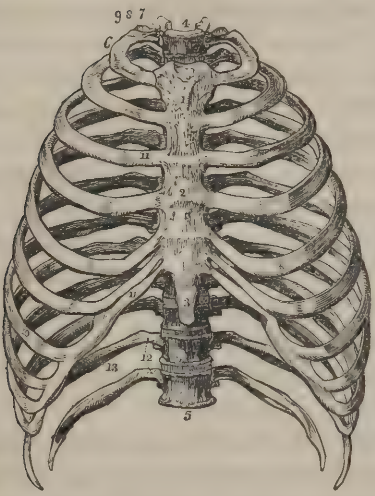
Are long crooked bones, placed in an oblique direction downwards as respects the back-bone. Their number is generally twelve on each side; though sometimes eleven or thirteen have been found.

They are convex externally, and concave internally. They are made smooth by the action of the contained parts, which, on this account, are in no danger of being hurt by them.

The ribs approach towards a round form at their extremities, near the vertebræ. Farther forwards they are flat and broad, and have an upper and lower edge; each of which is made rough by the action of the intercostal muscles inserted into them. These muscles being all of nearly equal force, and equally stretched in the interstices of the ribs, prevent the broken ends of these bones, in a fracture, from being removed far out of their natural place, to interrupt the motion of the vital organs. The upper edge of the ribs is more obtuse, and rounder than the lower, which is deepened on its internal side by a long fossa, for lodging the intercostal vessels and nerves: on each side of which there is a ridge, to which the intercostal muscles are fixed. The fossa is not observable at the ends of the ribs; for, at the posterior, or root, the vessels have not yet reached the bones; and, at the fore end, they are split away into branches, to serve the parts between the ribs.

From this situation of the blood-vessels, has originated the rule adopted by surgeons, that the incision, in cases of empyema, &c., should be made midway between the spine and sternum, and that the lower edge of the upper rib should be avoided.

Fig. 37.*



At the posterior end of each rib, a little head is formed, which is divided by a middle ridge into two flat or hollow surfaces; the lowest of which is generally the broadest and deepest. The two surfaces are joined to the bodies of two different vertebræ, and the ridge forces itself into the intervening cartilages. A little way from this head, we find, on the external surface, a small cavity, where mucilaginous glands are lodged; and round the head, the bone appears spongy, where the capsular ligament of the articulation is fixed. Immediately beyond this, a flattened tubercle rises, with a small cavity at its root, which is surrounded by a roughness, for the articulation of the rib with the transverse process of the lowest of the two vertebræ, with which the head of the rib is joined. Advancing farther on this external surface, another smaller tubercle may be observed in most cases, into which ligaments connecting the ribs to each other, and to the transverse processes of the vertebræ and portions of the longissimus dorsi, are inserted. Beyond this, these bones are made flat by the sacro-lumbalis muscle, which is inserted into the part of this flat surface farthest from the spine, where each rib makes a considerable curve, called by some its *angle*. Then the rib

* An anterior view of the thorax. 1. The superior piece of the sternum. 2. The middle piece. 3. The inferior piece, or ensiform cartilage. 4. The first dorsal vertebra. 5. The last dorsal vertebra. 6. The first rib. 7. Its head. 8. Its neck, resting against the transverse process of the first dorsal vertebra. 9. Its tuberosity. 10. The seventh or last true rib. 11. The costal cartilages of the true ribs. 12. The two last false ribs—the floating ribs. 13. The groove along the lower border of the rib for the lodgment of the intercostal vessels and nerve.

begins to turn broad, and continues so to its anterior end, which is hollow and spongy, for the reception of, and firm coalition with, the cartilage that runs thence to be inserted into the sternum, or to be joined with some other cartilage. In adults, the cavity at this end of the ribs is generally smooth.

The *substance* of the ribs is spongy, cellular, and only covered with a very thin external lamellated surface, which increases in thickness and strength as it approaches the vertebræ.

To the fore end of each rib a long, broad, and strong cartilage is fixed, which reaches the sternum, or is joined to the cartilage of the next rib. This course, however, is not in a straight line with the rib: for the cartilages generally make a considerable flexure, the concave part of which is upwards; therefore, at their insertion into the sternum, they make an obtuse angle above, and an acute one below. These cartilages are of such a length as never to allow the ribs to come to a right angle with the spine; but they keep them situated so obliquely as to make the angle very considerably obtuse above, till a force exceeding the elasticity of the cartilage is applied. These cartilages, as all others, are firmer and harder internally than they are on their external surface; and, sometimes, in old people, all their middle substance becomes bony, while a thin cartilaginous lamella appears externally. The ossification, however, begins frequently at the external surface. The greatest alternate motions of the cartilages being made at their great curvature, that part remains frequently cartilaginous after all the rest is ossified.

The ribs then are *articulated* at each end, and that behind is doubly joined to the vertebræ; for the head is received into the cavities of two bodies of the vertebræ, and a larger tubercle is received into the depression in the transverse process of the lower vertebræ. When we examine the double articulation, we must immediately see, that no other motion can here be allowed than upwards and downwards. Since the transverse process hinders the rib to be thrusted back, the resistance of the sternum on the other side prevents the ribs coming forward; and each of the two joints, with the other parts attached, oppose its

turning round. But then it is likewise as evident, that even the motion upwards and downwards can be but small in any one rib at the articulation itself. But as the ribs advance forwards, the distance from their centre of motion increasing, the motion must be larger; and it would be very conspicuous at their anterior ends, were they not resisted there by the cartilages which yield so little, that the principal motion is performed by the middle part of the ribs, which turns outwards and upwards, and occasions the twist remarkable in the long ribs at the place near their fore end where they are more resisted.

The ribs differ from each other in the following respects:

The upper rib is the most crooked; and as they descend they become straighter. Their obliquity, with respect to the spine, increases as they descend, so that though their distances from each other are nearly equal at their back part, yet at their fore ends the distances between the lower ribs must increase. In consequence of this increased obliquity of the lower ribs, each of their cartilages makes a greater curve in its progress from the rib towards the sternum; and the tubercles that are articulated to the transverse processes of the vertebræ, have their smooth surfaces gradually facing more upwards. The ribs becoming thus more oblique, while the sternum advances forwards in its descent, makes the distance between the sternum and the anterior end of the lower ribs greater than between the sternum and the ribs above; consequently, the cartilages of those ribs that are joined to the breast bone are longer in the lower than in the higher ones. These cartilages are placed nearer to each other as the ribs descend, which occasions their curvature to be greater.

The length of their ribs increases from the first and upper most rib, as far down as the seventh; and from that to the twelfth, it gradually diminishes. The superior of the two surfaces, by which the ribs are articulated to the bodies of the vertebræ, gradually increases from the first to the fourth rib, and is diminished after that in each lower rib. The distance of their angles from the heads always increases as they

descend to the ninth, because of the greater breadth of the sacro-lumbalis muscle.

The ribs are commonly divided into *true* and *false*.

The *true* ribs are the seven uppermost of each side. Their cartilages are all gradually longer as they descend, and are joined to the breast bone: so that, being pressed constantly between two bones, they are flattened at both ends; and are thicker, harder, and more liable to ossify than the other carti lages that are not subject to so much pressure. These bones include the heart and lungs; and therefore are called true ribs.

The five inferior ribs of each side are the *false*, whose cartilages do not reach to the sternum; but on this account having less pressure, their substance is softer. To these five ribs the circular edge of the diaphragm is connected.

The first rib of each side is so situated, that the flat sides are above and below, while one edge is placed inwards, and the other outwards, or nearly so; therefore sufficient space is left above it for the subclavian vessels and the muscles; and the broad concave surface is opposed to the lungs. But in consequence of this situation, the channel for the intercostal vessels is not to be found. The head of this rib is not divided into two plane surfaces by a middle ridge, because it is only articulated with the first vertebra of the thorax. Its cartilage is frequently ossified in adults, and is united to the sternum at right angles. This first rib frequently has a ridge rising near the middle of its posterior edge, where one of the heads of the scalenii muscles rises. Farther forward it is flattened, or sometimes depressed by the clavicle.

The position of the second rib is such that its two broad surfaces have oblique aspects, inward and downwards, outwards, and upwards, so as to make the surface of the thorax uniform: and it may be observed of all the ribs, that the aspect of their surfaces is varied upon this principle, according to their situation in the thorax.

The sixth, seventh, and eighth ribs have their cartilages nearly contiguous. They are frequently joined to each other by cross cartilages; and frequently the cartilages of the eighth,

ninth, and tenth, are connected to the former, and to each other by firm ligaments.

The eleventh, and sometimes the tenth rib, has no tubercle for its articulation with the transverse process of the vertebra, to which it is only loosely fixed by ligaments. The fossa, in its lower edge, is not so deep as in the upper ribs; because the vessels run more towards the interstice between the ribs. Its front end is smaller than its body; and its short small cartilage is but loosely connected to the cartilage of the rib above.

The twelfth rib is the shortest and straightest. Its head is only articulated with the last vertebra of the thorax; and therefore is not divided into two surfaces. This rib is not joined to the transverse process of the vertebra, and therefore has no tubercle, being often pulled necessarily inwards by the diaphragm, which an articulation with the transverse process would not have allowed. The fossa is not found at its upper edge, because the vessels run below it. The forepart of this rib is smaller than its middle, and has only a very small pointed cartilage fixed to it. To its whole internal side the diaphragm is connected.

The Sternum

Is the broad flat bone, in the front part of the thorax. In adults it is composed of three pieces, which easily separate after the cartilages connecting them are destroyed. The two lower pieces are frequently found intimately united; and very often, in old people, the sternum is a continued bony substance from one end to the other; though we still observe two, sometimes three, transverse lines on its surface; which are marks of the former divisions.

The sternum, considered as one bone, is broadest and thickest above, and smaller as it descends. The internal surface of this bone is somewhat concave for enlarging the thorax: but the convexity on the external surface is not so conspicuous, because the sides are pressed outwards by the true ribs; the round heads of whose cartilages are received into seven smooth pits, formed in each side of the sternum, and are kept firm there by

strong ligaments, which, on the external surface, have a particular radiated texture. The pits, at the upper part of the sternum, are at the greatest distance one from another, and as they descend, are nearer; so that the two lowest are contiguous.

The *substance* of the breast bone is cellular, with a very thin external plate, especially on its internal surface, where we may frequently observe a cartilaginous crust spread over it. On both surfaces, however, a strong ligamentous membrane is closely braced; and the cells of this bone are so small, that a considerable quantity of osseous fibres must be employed in the composition of it. Whence, with the defence which the muscles give it, and the movable support it has from the cartilages, it is sufficiently secured from being broken: for it is strong by its quantity of bone; its parts are kept together by ligaments; and it yields enough to elude considerably any violence offered.

The three pieces which compose this bone are very different from each other.

The *first* piece resembles a triangle, with the corners cut off. The upper edge of it is thick, and has a regular depression in the middle, to accommodate the trachea. On each side of this depression is a superficial cavity, which, on viewing it transversely, from before backwards, appears a little convex. Into these cavities the ends of the clavicles are received. Immediately below them, the sides of this bone become thinner; and in each a superficial cavity, or a rough surface is to be seen, where the first ribs are received or joined to the sternum. In the side of the under end of this first bone, the half of the pit for the second rib on each side is formed. The upper part of the surface behind is covered with a strong ligament, which secures the clavicles; and is afterwards to be more particularly taken notice of.

The *second*, or middle division of this bone, is much longer, narrower, and thinner, than the first; but, excepting that it is a little narrower above than below, it is nearly uniform in its

dimensions of breadth or thickness. In the sides of it are complete pits for the third, fourth, fifth, and sixth ribs, and one half of the pits for the second and seventh; the lines, which are marks of the former division of this bone, being extended from the middle of the pits of one side, to the middle of the corresponding pits of the other side. Near its middle an unossified part of the bone has sometimes been found; which, freed of the ligamentous membrane or cartilage that fills it, is described as a hole. When the cartilage between this and the first bone is not ossified, a manifest motion of this upon the first may be observed in respiration; or in raising the sternum, by pulling the ribs upwards; or distending the lungs with air, in a recent subject.

The *third* bone is much less than the other two, and has only one half of the pit for the seventh rib formed in it; wherefore it might be reckoned only an appendix of the sternum. In young subjects it is always cartilaginous, and is better known by the name of *cartilago-xiphoides* or *ensiformis*, than any other. This third bone is seldom of the same figure, magnitude, or situation, in any two subjects; for, sometimes, it is triangular; with one of the angles below, and perpendicular to the middle of the upper side, by which it is connected to the second bone. In other persons, the point is turned to one side; or obliquely forwards or backwards. Frequently it is nearly of an equal breadth, and often it is bifurcated; sometimes, also, it is unossified in the middle. In the greatest number of adults, it is ossified, and tipped with a cartilage; in some, one half of it is cartilaginous; and in others, it is all in a cartilaginous state.

The sternum is *joined* by cartilages to the seven upper ribs, except when the first coalesce with it. It is also articulated with the clavicles.

It contributes to the formation of the cavity of the thorax, and supports the mediastinum. As a movable fulcrum for the ribs, it assists in respiration; and it affords origin and insertion to several muscles.

The movement of the Ribs and Sternum in respiration.

The ribs and their cartilages are articulated to the spine behind, and the sternum before, in a way which admits of a compound motion.

They are drawn from a position which slopes obliquely downwards and forwards, into one which is more horizontal; and the posterior extremity of each rib, which is the centre of this motion, is moved very little, while the anterior extremity moves much more.

At the same time, the ribs perform a rotation outwards, upon their extremities connected with the spine and sternum; in consequence of which, the middle of each rib is moved outwards to a considerable extent.

It is very obvious, that, by these motions, the thorax must be enlarged from side to side, and from behind forwards.

As the ribs are raised from the oblique towards the horizontal position, the sternum is necessarily moved forward by them; and, if this bone does not move upon the first rib, the rib must move to accommodate it: a small motion at the articulation of the rib with the spine, being sufficient to produce considerable motion at the lower end of the sternum. The sternum, therefore, vibrates forward when the ribs are elevated, and backward when they are depressed.

In easy respiration, these motions are not very great, for then the enlargement of the thorax appears to be produced by the increase of its vertical diameter, in consequence of the descent of the diaphragm; but when the inspirations are very large, and when the descent of the diaphragm is impeded, as in pregnancy, and in ascites, these motions are very considerable.

It ought to be observed, that the first rib has very little motion, except the rotation which favours the motion of the sternum; and that the lower ribs, having no support at their anterior extremities, have no rotation.

The Pelvis.

The pelvis is the cavity at the lower part of the trunk, formed by the os sacrum, os coccygis, and ossa innominata.

The ossa innominata are the two large bones which are connected to the sacrum behind, and to each other by the intervention of a cartilage in front.

Each of the ossa innominata is composed of three portions, in children ; and although these are united in adults, so as to form but one bone, yet anatomists have generally considered the bone as divided into its original parts, which are denominated os ilium, os ischium, and os pubis.

The original separation was at the acetabulum, or cavity for receiving the head of the os femoris, which is on the outside of the os innominatum. The upper and posterior part of this cavity, to the amount of two-fifths, is formed by the os ilium, two-fifths of the inferior portion by the os ischium, and the anterior fifth by the os pubis.

The Os Ilium

Fig. 38.*

Is the largest of the three portions. Its external surface has been called its dorsum, and the internal concave surface its costa or venter. The semicircular edge at the upper part of the bone, is named the spine or crest; the external oblique muscle of the abdomen is inserted into it, and the internal oblique, and the transversalis arise from it. The ends of the spine are prominent, and therefore are called pro-

* The os innominatum of the right side. 1. The ilium; its external surface. 2. The ischium. 3. The os pubis. 4. The crest of the ilium. 5. The superior curved line. 6. The inferior curved line. 7. The surface for the gluteus maximus. 8. The anterior superior spinous process. 9. The anterior inferior spinous process. 10. The posterior superior spinous process. 11. The posterior inferior spinous process. 12. The spine of the ischium. 13. The great sacro-ischiatic notch. 14. The lesser sacro-ischiatic notch. 15. The tuberosity of the ischium, showing its four surfaces. 16. The ramus of the ischium. 17. The body of the os pubis. 18. The ramus of the pubis.

cesses. In front the crest terminates in the anterior superior spinous process; below this is another protuberance, called the inferior anterior spinous process; and the edge of the bone between these two processes is curved.

Behind the crest terminates in the posterior superior spinous process; below this another protuberance is also observable, (*post. inf. spin. process*) which is applied closely to the os sacrum. Under this is a large notch, which, with the ligaments that pass from the os sacrum to the os ischium, forms a foramen, through which the great sciatic nerve, the pyriform muscle, and some blood-vessels pass.

The external surface, or dorsum, of the os ilium, is greatly undulated by the action of muscles that lie upon it; the gluteus maximus, on the posterior, and the gluteus medius and minimus, on the anterior parts of it. The lower part of this bone, which contributes to the formation of the acetabulum, is the thickest.

The internal surface of the os ilium is concave, and supports some of the intestines. From this concave surface a slight concavity is continued obliquely forwards, at the inside of the anterior inferior spinous process, where part of the psoas and iliacus muscles, with the crural vessels and nerves pass. The large concavity is bounded below by a sharp ridge, which runs from behind forwards; and, being continued with such another ridge of the os pubis, forms a line of partition between the cavities of the abdomen and pelvis. Into this ridge called *linea ilia innominata* the broad tendon of the psoas parvus is inserted.

All the internal surface of the os ilium, behind the continuance of this ridge, is very unequal: for the upper part is flat, but spongy, where the sacro-lumbalis and longissimus dorsi rise. Lower down, there is a transverse ridge from which ligaments go out to the os sacrum. Immediately below this ridge, the rough unequal cavities and prominences are placed, which are exactly adapted to those described on the side of the os sacrum. In the same manner, the upper part of this rough surface is porous, for the firmer adhesion of the ligamentous cellular substance; while the lower part is more solid, and covered with a thin cartilaginous skin, for its immovable arti-

culation with the os sacrum. From all the circumference of this large unequal surface, ligaments are extended to the os sacrum, to secure more firmly the conjunction of these bones.

The passages of the medullary vessels are very conspicuous, both in the dorsum and costa of many ossa ilia; but in others they are inconsiderable.

The posterior and lower parts of these bones are thick; but they are generally exceedingly thin and compact at their middle, where they are exposed to the actions of the musculi glutæi and iliacus internus, and to the pressure of the bowels contained in the belly. The substance of the ossa ilia is cellular, except a thin external plate.

The Os Ischium,

Or, hip-bone, is of a middle size, between the two other parts of the os innominatum, and of a very irregular figure. Its extent might be marked by a horizontal line drawn a little below the middle of the acetabulum; for the upper bulbous part of this bone forms rather less than the lower half of that great cavity, and the small leg of it rises to much the same height on the other side of the great hole common to this bone and the os pubis.

From the upper thick part of the os ischium, a sharp process, called by some authors *spinous,* stands out backwards, from which chiefly the musculus coccygæus and superior gemellus, and part of the levator ani, rise; and the anterior, or internal sacro-sciatic ligament is fixed to it. Between the upper part of this ligament and the bones, it was formerly observed, that the pyriform muscle, the posterior crural vessels, and the sciatic nerve, pass out of the pelvis. Immediately below this process, is a depression for the tendon of the obturator internus muscle. In a recent subject, this part of the bone serves as a pulley on which the obturator muscle plays with a ligamentous cartilage.

Below the depression of the obturator muscle, is the great knob or tuberosity, covered with cartilage or tendon. The upper part of the tuberosity gives rise to the inferior gemellus

muscle. To a ridge at the inside of this, the external, or posterior sacro-sciatic ligament is so fixed, that between it, the internal ligament, and the sinuosity of the os ischium, a passage is left for the internal obturator muscle. The upper thick smooth part of the *tuber*, called by some its *dorsum*, has two oblique impressions on it. The inner one gives origin to the long head of the biceps flexor cruris, and semitendinosus muscles; and the semimembranosus rises from the exterior one, which reaches higher and nearer the acetabulum than the other. The lower, thinner, more scabrous part of the knob, which bends forwards, is also marked with two flat surfaces; whereof the internal is what we lean upon in sitting, and the external gives rise to the largest head of the triceps adductor femoris. Between the external margin of the tuberosity, and the great hole of the os innominatum, there is frequently an obtuse ridge extended down from the acetabulum, which gives origin to the quadratus femoris. As the tuber advances forwards, it becomes smaller, and is rough for the origin of the musculus transversalis and erector penis. The small leg of it, which mounts upwards to join the os pubis, is rough and prominent at its edge, where the two lower heads of the triceps adductor femoris take their rise.

The upper and back part of the os ischium is broad and thick; but its lower and forepart is narrower and thinner. Its substance is of the structure common to broad bones.

The os ilium and pubis, of the same sides, are the only bones which are contiguous to the os ischium.

The Os Pubis,

The least of the three portions of the os innominatum, is placed at the upper and front part of it. The thick, largest part of this bone is employed in forming the acetabulum; from which, becoming much smaller, it is stretched inwards to its fellow of the other side, where it again grows larger, and forms a surface to be connected with the cartilage of its symphysis and then sends a small branch downwards to join the

end of the small leg of the os ischium. The upper surface of each os pubis is broad, near its junction with the cartilage of the symphysis; on the internal edge of this surface begins a ridge, which is continued from it along the os ilium, and forms the division between the cavities of the abdomen and pelvis. This ridge is called crista, and including that on the ilium, forms the linea innominata, or ileo-pectinea. On the anterior and external edge of this surface of the pubis, at a small distance from the cartilage, is a prominence or process, called the spine. From this process, another ridge, which is much more obtuse, extends to the acetabulum. The upper surface of the pubis, which is included between these ridges, is concave, for the transmission of the crural vessels and nerve, and the psoas and iliacus internus muscles.

Immediately below the lower ridge, and near the acetabulum, a winding notch is made, which is comprehended in the great contiguous foramen; but is formed into a hole in the recent subject by a subtended ligament, for the passage of the posterior crural nerve, and artery, and vein. The internal end of the os pubis is rough and unequal, for the firmer adhesion of the thick ligamentous cartilage that connects it to its fellow of the other side. The process which goes down from that to the os ischium is broad and rough before, where the gracilis and upper heads of the triceps adductor femoris have their origin.

The substance of the os pubis is the same as that of other broad bones.

Between the os ischium and pubis a very large irregular hole is left, which has been called *obturator thyroid.* The whole of this foramen, except the notch for the posterior crural nerve, is filled up, in a recent subject, with a strong ligamentous membrane, that adheres very firmly to its circumference. From this membrane chiefly, the two external and internal obturator muscles take their rise. The great design of this hole, besides rendering the bone lighter, is, to allow a strong origin to the obturator muscles, and sufficient space for lodging them; that there may be no danger of disturbing the functions of the con-

tained viscera of the pelvis by the actions of the internal; nor of the external being bruised by the thigh bone, especially by its lesser trochanter, in the motions of the thigh inwards: both which inconveniences must have happened, had the ossa innominata been complete here, and of sufficient thickness and strength, as the fixed point of these muscles.

The bowels sometimes make their way through the notch for the vessels at the upper part of this thyroid hole; and this causes a hernia at this place.

The acetabulum is situated near the outside of the great foramen. The margin of this cavity is very high, and is still much more enlarged by the ligamentous cartilage, with which it is tipped in a recent subject; round the base of this margin the bone is rough and unequal, where the capsular ligament of the articulation is fixed. At the upper and back part of the acetabulum the margin is much larger and higher than any where else; which is very necessary to prevent the head of the femur from slipping out of its cavity at this place, where the whole weight of the body bears upon it, and consequently might otherwise thrust it out. As the margin is extended downwards and forwards, it becomes less; and, at the internal lower part, is a deficiency in it; from the one side of which to the other, a ligament is placed in the recent subject, under which a large hole is left. Besides this difference in the height of the margin, the acetabulum is otherwise unequal; for the lower internal part of it is depressed below the cartilaginous surface of the upper part, and is not covered with cartilage; into the upper part of this particular depression, where it is deepest, and of a semilunar form, the ligament of the thigh bone, commonly, though improperly called the *round one*, is inserted: while, in its more superficial lower part, a mass of adipose matter is lodged. The greatest part of this separate depression is formed in the os ischium.

The *ossa innominati* are *joined*, at their back part, to each side of the os sacrum, by a sort of suture, with a very thin intervening cartilage, which serves to cement these bones together: and strong ligaments go from the circumference of

this unequal surface to connect them more firmly. They are connected together at their forepart by the ligamentous cartilage interposed between the two ossa pubis, and therefore have no motion in a natural state, except what is common to the trunk of the body, or to the os sacrum.

Considering the great weight that is supported in our erect posture, by the articulation of the ossa innominati with the os sacrum, there is great reason to think, that, if the conglutinated surfaces of these bones were once separated, (without which the ossa pubis cannot move on each other,) the ligaments would be violently stretched, if not torn.

Each os innominatum affords a socket (the acetabulum) for the thigh bones to move in ; and the trunk of the body rolls so much on the heads of the thigh bones as to allow here the most conspicuous motions of the trunk, which are commonly thought to be performed by the bones of the spine.

The form of the cavity of the pelvis, at its upper opening, or brim, is somewhat oval ; as a line drawn from one side to the other, is about an inch longer than a line drawn from the back to the front part of it.

This margin is well defined by the ridge on the surface of the ossa ilia, and the upper edge of the os pubis; but the margin of the lower opening is very irregular; and it ought to be observed, that the dimensions of this opening are made less by the sacro-sciatic ligaments, than they appear upon an examination of the bare bones.

In consequence of the oblique position of the sacrum, sloping downwards and backwards, the position of the pelvis is very oblique. A line drawn through the centre of this cavity, perpendicular to the plane of the upper orifice, or brim, would not coincide with the vertical diameter of the cavity of the abdomen, but would pass out of that cavity near the umbilicus.

This cavity, and the bones which form it, are different in the two sexes.

In women, the brim of the pelvis is wider, and inclines more to the oval form.

In men this opening is more circular.

The outlet or lower opening of the pelvis is also larger in women.

This greater size of the pelvis and its openings, in women, is derived particularly from the following circumstances:

The os sacrum is broader, and sometimes straighter than in men.

The ossa ilia are flatter, and consequently the ossa ischia are farther apart.

The ligamentous cartilage at the symphysis pubis is broader, and shorter.

The angle formed by the crura of the ossa pubis with each other, at the symphysis, is much larger.

—The pelvis, considered as a whole, is very irregular, though symmetrical in its shape. It has the form of a truncated cone, or a funnel with its base upwards, curved from behind forward with its concavity in front, and is bounded both above and below by bony walls of unequal elevation. It is divided by the projection of the base of the sacrum and the two ilio-pectineal lines, into a *greater* and *lesser pelvis*, the former of which is above. The dividing line is called the superior strait of the lesser pelvis. The bony walls of the greater pelvis is incomplete. The boundaries of this cavity, are formed upon the sides by the iliac fossæ, and behind by a notch which is nearly filled up, when the last lumbar vertebræ is left connected with the sacrum;* and in front by all the wide triangular opening between the anterior superior spine of the ilium of each side and the symphysis pubis which is filled up by the lower part of the abdominal muscles. From the flaring direction of the upper part of the ilia, the diameters of the base of this cavity, or that towards the abdomen, is greater than those opposite the ilio-pectineal lines.

—The *lesser pelvis*, forms nearly an entire bony canal, and which the student is too apt to consider as constituting the whole pelvis. This cavity is larger at its middle than at its extremities. It is bounded behind by the sacrum and coccyx; in front by the

* The attachment of the lumbar muscles completes this wall behind.

symphysis pubis and a part of the obturator foramen; and upon the sides, by the bony surface which corresponds to the cotyloid cavity. Its superior margin *(superior strait,)* is regular and ovoidal in its shape. Its longest diameter is transverse. Its inferior strait is very irregular, though symmetrical in the form of its bony walls; and in consequence of the posterior walls of this pelvis being of much greater length than the anterior, presents an oblique cut, which faces slightly forwards, so that if its axis was extended downwards, it would cross just above the middle of the thigh. It is bounded behind, by the point of the coccyx; in front, by the symphysis pubis; and on the side, by the tuberosities of the ischium. The sacro-sciatic notches and the arch of the pubis, are filled up by ligaments and soft parts. From the general form of the whole pelvic cavity it will then be obvious, that a body passing through its axis from above downwards, must advance successively in *three directions:* 1st, as it passes through the greater pelvis, *obliquely backwards;* 2d, *vertically;* and 3d, as it passes through the inferior strait, *obliquely forwards.*

—For obstetrical purposes, it is necessary for the student to have precise notions in regard to the dimensions of the pelvis. To determine this, it is necessary to measure the superior opening of the greater pelvis, and the two straits of the lesser.

—The pelvis of the male, differs in many respects from that of the female. In the former length predominates, in the latter, breadth. In the female all the diameters of the pelvis are more extensive than those of the male, which is caused by the greater size and outward direction of the iliac fossæ, from a less degree of curvature in the iliac crests, and from the roundness of the pubic arch which in the male forms an acute angle. In consequence of the wider space which exists between the cotyloid cavities, the gait of the female is characterised by more lateral rotation or waddling, than that of man.

—In a well formed woman, the different measurements are nearly as follows:

Greater Pelvis.

—In the superior opening of the greater pelvis, we distinguish but two diameters, both transverse. The *posterior* extended from the middle of one iliac crest to the other, eleven inches. The *anterior*, between the two anterior superior spinous processes of the ilium, ten inches. From the middle of the iliac crest, to the superior strait, three and a half inches. From the middle of the iliac crest to the tuberosity of the ischium, (whole depth of the pelvis) seven and a half inches nearly.*

Lesser Pelvis.

Superior Strait, sometimes called abdominal.	Inches.	*Inferior Strait, or perineal.*	Inches.
Antero-posterior diameter, from the symphysis of the pubis to the promontory of the sacrum, - -	4	*Antero-posterior* diameter, between the symphysis pubis and front of the coccyx, which may be increased near an inch by the mobility of the coccyx backwards,	4
Transverse, or iliac, which crosses the former, at a right angle, - - - - - -	5	*Transverse*, or ischiatic, from one tuberosity of the ischium to the other, - - - -	4
Oblique, from the acetabulum of one side, to the sacro-iliac articulation of the other, - -	$4\frac{1}{2}$	*Oblique*, from the tuberosity of the ischium of one side, to the middle of the great sacro sciatic ligament of the other, nearly - -	4

The height of the posterior wall of the lesser pelvis, formed by the sacrum and coccyx, (of which the latter forms an inch,) is nearly - - - -	5	inches.
Height of the anterior wall formed by the os pubis,	$1\frac{1}{2}$	"
Height of the lateral walls, - - - - -	$3\frac{1}{2}$	"
Thickness of the symphysis pubis, about - -	$\frac{1}{2}$	"
Depth or sine of the cavity of the sacrum,† nearly -	1	"

The Trunk of the Fœtus.

At birth, each *vertebra* consists of three pieces, connected by

* The depth or length of the pelvis is rather greater in the male than in the female

† Dimensions of the child's head at birth. The long diameter, from the vertex or posterior extremity of the sagittal suture to the chin, $5\frac{1}{4}$ inches; antero-posterior, from the middle of the frontal bone to the tubercle of the occipital, 4 inches; transverse, from one parietal protuberance to the other, $3\frac{1}{2}$ inches.

cartilages, viz.: The *body*, not perfectly ossified; and a *bone on each side of it*, of a form almost rectangular, on which the *oblique processes* are very distinguishable, and the *transverse processes* may be ascertained. These bones are so applied to the body, as to include a triangular space for the vertebral cavity. The ends of the longest portions are nearly in contact behind; but the *spinous process* is not formed. The *atlas* is cartilaginous in front, and has only the two lateral portions ossified. The *vertebra dentata* consists of four pieces; for, in addition to the three pieces common to the other vertebræ, the *processus dentatus* is a distinct portion.

The *false vertebræ*, of which the *sacrum* consists, are each formed of three bones as the true vertebræ.

The bones of the *os coccygis* are cartilaginous, except the first, which is partly ossified.

The *ribs* are almost perfect at birth: their heads and tubercles covered with cartilage. The necessity of their motion in respiration, immediately after birth, explains this difference between them, and most of the other bones of the fœtus.

The *sternum* consists of several small bones, surrounded by flat cartilages. Ossification goes on in these cartilages from various points; and the distinct bones finally unite into the three pieces of which the sternum is finally composed.

The *ossa innominata*, on each side, are formed of three distinct pieces, united at the acetabulum.

The *spine* of the *os ilium* is cartilaginous; and the lower part of the bone is not completely ossified.

The back part of the *os ischium* is ossified; but the portion which forms the acetabulum, the tuber, and the crus, is cartilaginous.

The upper part of the *os pubis*, and that portion which forms the symphysis, are ossified. The crus, like that of the ischium, is cartilaginous.

Of the Superior Extremities.

Each superior extremity consists of the Shoulder, the Arm, the Forearm, and the Hand.

The *shoulder* is composed of the *clavicle* and *scapula.* It has been supposed by some persons that the two last mentioned bones belong properly to the thorax; but upon examining the motions of the upper extremity, it will appear that they form an essential part of it: and it is equally evident that they do not contribute to the perfection of the thorax; they are, therefore, considered as a part of the upper extremity.

The Clavicle,

Is the long crooked bone resembling the italic *ſ*, which is placed almost horizontally between the upper lateral part of the sternum and the acromion, or most prominent process of the scapula which it keeps off from the trunk of the body.

The clavicle, as well as other long bones, is larger at its two ends than in the middle. The end next to the sternum is triangular; the angle behind is considerably protruded, to form a sharp ridge, to which the transverse ligament, extended from one clavicle to the other, is fixed. The side opposite to this is somewhat rounded. The middle of this protuberant end is irregularly hollowed, as well as the cavity in the sternum for receiving it: but, in a recent subject, the irregular concavities of both are supplied by a movable cartilage; which is not only much more closely connected every where, by ligaments, to the circumference of the articulation, than those of the lower jaw are, but it grows to the two bones at both its internal and external end; its substance at the external end being soft, but very strong, and resembling the intervertebral cartilages.

From its internal end, the clavicle, for about two-fifths of its length is bended obliquely forwards. On the upper and front part of this curvature a small ridge is seen, with a plane rough surface before it; whence the sterno-hyoideus and sterno-mastoideus muscles have in part their origin. Near the lower angle, a small plane surface is often to be remarked, where the first rib and this bone are contiguous, and are connected by a firm ligament. From this a rough plane surface is extended outwards, where the pectoral muscle has part of its origin. Behind, the bone is made flat and rough by the insertion of the larger

share of the subclavian muscle. The clavicle is then curved backwards, and at first is round; but it soon after becomes broad and thin; which shape it retains to its external end. Along the external concavity a rough sinuosity runs; from which some part of the deltoid muscle takes its rise: opposite to this, on the convex edge, a scabrous ridge gives insertion to a share of the trapezius muscle. The upper surface of the clavicle is here flat; but the lower is hollow, for lodging the beginning of the musculis subclavius; and towards its back part a tubercle rises; to which, and to a roughness near it, the strong, short, thick ligament, connecting this bone to the coracoid process of the scapula, is fixed.

The external end of this bone is oblong horizontally, smooth, sloping at the posterior side, and tipped in a recent subject with a cartilage, for its articulation with the acromion scapulæ. Round this the bone is spongy, for the firmer connexion of the ligaments.

The surfaces of contact with this bone, and the scapula are remarkably small, and flat also.

The medullary arteries, having their direction obliquely outwards, enter the clavicles by one or more small passages in the middle of their back part.

The *substance* of this bone is the same as that of the other round long bones.

The ligaments which surround the articulation of this bone with the sternum, are so short and strong, that little motion can be allowed any way; and the strong ligament that is stretched across the upper forcula of the sternum, from the posterior prominent angle of the one clavicle to the same place of the other clavicle, serves to keep each of these bones more firmly in its place. By the assistance, however, of the movable intervening cartilage, the clavicle can move at this articulation, so that the external extremity may be elevated or depressed, and moved backwards and forwards. The whole bone may be moved so as to describe a cone; of which the end at the sternum is the apex.

The movements of the scapula and arm are the objects of

these motions of the clavicle; and the general use of the bone is to regulate the motions of these parts.

From the situation, figure, and use of the clavicles, it is evident that they are much exposed to fractures; that their broken parts must generally pass each other, and that they will be kept in their places with difficulty.

The Scapula,

Or *shoulder-blade*, is the triangular bone situated on the upper and back part of the thorax. The back part of the scapula has nothing but the thin ends of the serratus anticus major, and subscapularis muscles between it and the ribs: but as this bone advances forwards, its distance from the ribs increases. The longest side of this bone is nearest the spine, and has an oblique position as respects it. The upper or shortest side, called the *superior costa* of the scapula, is nearly horizontal, and parallel with the second rib. The lower side, which is named the *inferior costa*, is extended obliquely from the third to the eighth rib. The situation of this bone, here described, is, as when people are sitting or standing, in a state of inactivity, and allowing the members to remain in the most natural easy posture. The inferior angle of the scapula is very acute; the upper one is near to a

Fig. 39.*

* A posterior view of the scapula. 1. The supra-spinous fossa. 2. The infra-spinous fossa. 3. The superior border. 4. The supra-scapular notch. 5. The anterior or inferior border. 6. The head of the scapula and glenoid cavity. 7. The inferior angle. 8. The neck of the scapula, the ridge opposite the number gives origin to the long head of the triceps. 9. The posterior border or base of the scapula. 10. The spine. 11. The triangular smooth surface, over which the tendon of the trapezius glides. 12. The acromion process. 13. One of the nutritious foramina. 14. The coracoid process.

right angle; and what is called the anterior does not deserve the name, for the two sides do not meet to form an angle. The body of this bone is concave towards the ribs, and convex behind, where it has the name of *dorsum.* Three processes are generally reckoned to proceed from the scapula. The first is the large spine that rises from its convex surface behind, and divides it unequally. The second process stands out from the forepart of the upper side; and, from its imaginary resemblance to a crow's beak, is named *coracoides.* The third process is the whole thick bulbous forepart of the bone.

Into the oblique space the musculis patientia *(levator scapulæ)* is inserted. At the root of the spine, on the back part of the base, a triangular flat surface is formed by the pressure of the lower fibres of the trapezius. Below this, the edge of the scapula is scabrous and rough, for the insertion of the serratus major anticus and rhomboid muscles.

The back part of the inferior angle is made smooth by the latissimus dorsi passing over it. The muscle also alters the direction of the inferior costa some way forwards from this angle: and so far it is flattened behind by the origin of the teres major. As the inferior costa advances forward, it is of considerable thickness, is slightly hollowed, and made smooth behind, by the teres minor; while it has a fossa formed into it below, by part of the subscapularis; and between the two, a ridge with a small depression appears, where the extensor longus cubiti has its origin.

The superior costa is very thin; and near its forepart there is a semi-lunar notch, from one end of which to the other, a ligament is stretched; and sometimes the bone is continued to form one, or sometimes two holes, for the passage of the scapular blood-vessels and nerves. Immediately behind this semilunar cavity, the coraco-hyoideus muscle has its rise. From the notch, to the termination of the fossa for the teres minor, the scapula is narrower than any where else, and supports the third process. This part has the name of *cervix.*

The whole dorsum of the scapula is always said to be convex; but, by reason of the raised edges that surround it, it is

divided into two cavities by the spine, which is stretched from behind forwards, much nearer to the superior than to the inferior costa. The cavity above the spine is really concave, where the supra-spinatus muscle is lodged; while the surface of this bone below the spine, on which the infra-spinatus muscle is placed, is convex, except a fossa that runs at the side of the inferior costa.

The internal or anterior surface of this bone is hollow, except in the part above the spine, which is convex. The subscapularis muscle is extended over this surface, where it forms several ridges and intermediate depressions, commonly mistaken for prints of the ribs: they point out the interstices of the bundles of fibres of which the subscapularis muscle is composed.

The spine rises small at the base of the scapula, and becomes higher and broader as it advances forwards. On the sides it is unequally hollowed and crooked, by the action of the adjacent muscles. Its ridge is divided into two rough, flat surfaces: into the upper one the trapezius muscle is inserted; and the lower one has part of the deltoid fixed to it. The end of the spine, called *acromion*, or top of the shoulder, is broad and flat, and is, sometimes, only joined to the spine by a cartilage. The anterior edge of the acromion is flat, smooth, and covered with a cartilage, for its articulation with the external end of the clavicle; and it is hollowed below, to allow a passage to the infra and supra-spinati muscles, and free motion to the os humeri.

The coracoid process is crooked, with its point inclining forwards; so that a hollow is left at the lower side of its root for the passage of the subscapcularis muscle. The end of this process is marked with three plane surfaces. Into the internal, the pectoralis is inserted; from the external, one head of the biceps flexor cubiti rises; and from the lower one, the coracobrachialis has its origin. At the upper part of the root of this process, immediately before the semilunar cavity, a smooth tubercle appears, where a ligament from the clavicle is fixed. From the whole of the external side of this coracoid apophysis

a broad ligament goes out, which becomes narrower where it is fixed to the acromion.

From the cervix scapulæ the third process is produced. The forepart of this is formed into a glenoid cavity, which is of the shape of the longitudinal section of an egg, being broad below and narrow above. Between the margin of this cavity and the forepart of the root of the spine, a large sinuosity is left for the transmission of the supra and infra-spinati muscles; and on the upper part of this margin we may remark a smooth surface, where the second head of the biceps flexor cubiti has its origin. The root of the margin is rough all around, for the firmer adhesion of the capsular ligament of the articulation, and of the cartilage; the latter is thick on the margin, but becomes very thin as it is continued towards the middle of the cavity, which it lines all over.

The medullary vessels enter the scapula near the base of the spine.

The *substance* of the scapula, as in all other broad flat bones, is cellular, but of an unequal thickness: for the neck and third process are thick and strong; the inferior costa, spine, and coracoid process, are of a middle thickness; and the body is so pressed by the muscles, as to become thin and transparent.

The scapula and clavicle are *joined* by plane surfaces, tipped with cartilage; by which neither bone is allowed any considerable motion, being tightly tied down by the common capsular ligament, and by a very strong one which proceeds from the coracoid process; but divides into two before it is fixed into the clavicle, with such a direction as can either allow this bone to have a small rotation, in which its posterior edge turns more backwards, while the anterior one rises farther forwards; or it can yield to the forepart of the scapula moving down wards, while the back part of it is drawn upwards: in both which cases, the oblong, smooth articulated surfaces of the clavicle and scapula are not in the same plane, but stand a little transversely, or across each other, and thereby preserve this joint from luxations, to which it would be subject if either of

the bones were to move on the other perpendicularly up and down, without any rotation. Sometimes a movable ligamentous cartilage is found in this joint; and sometimes such a cartilage is only interposed at the anterior half of it; and in some old subjects a sesamoid bone has been found here.

The scapula is connected to the head, os hyoides, vertebræ, ribs, and arm bone, by muscles that have one end fastened to these parts, and the other to the scapula, which can move it upwards, downwards, backwards, or forwards: by the quick succession of these motions, its whole body is carried in a circle. But being also often moved, as upon an axis perpendicular to its plane, its circumference turns in a circle whose centre this axis is. Whichever of these motions it performs, it always carries the outer end of the clavicle and the arm along with it. The glenoid cavity of this bone receives the os humeri, which plays in it, as will be more fully explained hereafter.

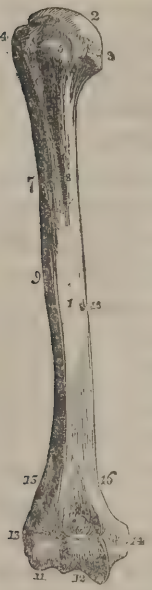
The *use* of the scapula is, to serve as a fulcrum to the arm; and by altering its position on different occasions, to allow always to the head of the os humeri a socket to move in properly situated; and thereby to assist and to enlarge greatly the motions of the superior extremity, and to afford the muscles which rise from it more advantageous actions, by altering their directions with respect to the bone which they are to move. This bone also serves to defend the back part of the thorax, and is often employed to sustain weights, or to resist forces too great for the arm to bear.

Os Humeri, or Arm Bone

The *arm* has only one bone, best known by the Latin name of *os humeri*; which is long, round, and nearly straight.

The upper end of this bone consists of a large round smooth head, which forms the segment of a sphere, whose axis is not in a straight line with the axis of the bone, but stands obliquely backwards from it. The extent of the head is distinguished by a circular fossa surrounding its base, where

Fig. 40.*



the head is united to the bone, and the capsular ligament of the joint is fixed. Below the forepart of its base, two tubercles stand out: the smaller one, which is situated most to the inside, has the tendon of the subscapularis muscle inserted into it. The larger more external protuberance is divided, at its upper part, into three smooth plane surfaces: into the anterior of which, the musculus supra-spinatus; into the middle or largest, the infra-spinatus; and into the one behind, the teres minor, is inserted. Between these two tubercles, exactly in the forepart of the bone, a deep long groove is formed, for lodging the tendinous head of the biceps flexor cubiti; which, after passing, in a manner peculiar to itself, through the cavity of the articulation, is tied down, by a tendinous sheath extended across the groove; in which, and in the neighbouring tubercles, are several remarkable holes, which are penetrated by the tendinous and ligamentous fibres, and by vessels. On each side of this groove, as it descends in the os humeri, a rough ridge, gently flattened in the middle, runs from the roots of the tubercles. The tendon of the pectoral muscle is fixed into the anterior of these ridges, and the latissimus dorsi and teres major are inserted into the internal one. A little behind the lower end of this last, another rough ridge may be observed, where the coraco-brachialis is inserted. From the back part of the root of the largest tubercle, a ridge also is continued; from which the extensor brevis cubiti arises. This bone is flattened on the

* The humerus of the right side; its anterior surface. 1. The shaft of the bone. 2. The head. 3. The anatomical neck. 4. The greater tuberosity. 5. The lesser tuberosity. 6. The bicipital groove. 7. The anterior bicipital ridge. 8. The posterior bicipital ridge. 9. The rough surface into which the deltoid is inserted. 10. The nutritious foramen. 11. The rounded protuberance of the articular surface. 12. The pulley-like surface. 13. The external condyle. 14. The internal condyle. 15. The external condyloid ridge. 16. The internal condyloid ridge. 17. The fossa for the coronoid process of the ulna.

inside, about its middle, by the belly of the biceps flexor cubiti. In the middle of this plane surface, the entry of the medullary artery is seen slanting obliquely downwards. At the foreside of this plane, the bone rises in a sort of ridge, which is rough, and often has a great many small holes in it, where the strong deltoid muscle is inserted; on each side of which the bone is smooth and flat, where the brachialis internus rises. The exterior of these two flat surfaces is the largest: behind it is a superficial spiral channel, formed by the muscular nerve, and the vessels that accompany it; it runs from behind forwards and downwards.

The body of the os humeri is flattened behind by the extensors of the forearm.

Near the lower end of this bone, a large sharp ridge is extended on its outside; from which the musculus supinator radii longus, and the longest head of the extensor carpi radialis, arise. Opposite to this there is another small ridge to which the aponeurotic tendon, that gives origin to the fibres of the internal and external brachial muscles, is fixed; and from a little depression on the foreside of it, the pronator radii teres arises.

The body of the os humeri becomes gradually broader towards the lower end, where it has several processes; at the roots of which there is a cavity before, and one behind, called sigmoid. The anterior is divided by a ridge into two; the external, which is the least, receives the end of the radius; and the internal receives the coronoid process of the ulna, in the flexions of the forearm; while the posterior deep triangular cavity lodges the olecranon in the extensions of that limb. The bone between these two cavities is pressed so thin by the processes of the ulna, as to appear transparent in many subjects. The sides of the posterior cavity are stretched out into two processes, one on each side. These are called *condyles;* from each of which a strong ligament goes out to the bones of the forearm. The external condyle, which has an oblique direction forwards with respect to the internal, when the arm

is in the most natural posture, is equally broad, and has an obtuse smooth head rising from it forwards. From the rough part of the condyle, several muscles arise; and on the smooth head the upper end of the radius plays. The internal condyle is more pointed and protuberant than the external, to give origin to the flexor muscles of the wrist and hands, &c. Between the two condyles, is the trochlea, or pulley; which consists of two lateral protuberances and a middle cavity that are smooth, and covered with cartilage. When the forearm is extended, the tendon of the internal brachialis muscle is lodged in the forepart of the cavity of this pulley. The external protuberance, which is less than the other, has a sharp edge behind: but forwards, this ridge is obtuse, and only separated from the little head, already described, by a small fossa, in which the adjoining edges of the ulna and radius move. The internal protuberance of the pulley is largest and highest; and therefore, in the motions of the ulna upon it, that bone would be inclined outwards, were it not supported by the radius on that side. Between this internal protuberance and condyle, a sinuosity may be remarked, where the ulnar nerve passes.

The *substance* and the internal structure of the os humeri are the same, and disposed in the same way, as in the other long bones.

The round head, at the upper end of this bone, is *articulated* with the glenoid cavity of the scapula; which being superficial and having long ligaments, allows the arm a free and extensive motion. These ligaments are, however, considerably strong. For, besides the common capsular ligament, the tendons of the muscles perform the office, and have been described under the name of *ligaments.* Then the acromion and coracoid process, with the strong broad ligaments stretched between them, secure the articulation above; where the greatest and most frequent force is applied, to thrust the head of the bone out of its place. It is true, that there is not near so stong a defence in the lower part of the articulation; but, in the ordinary postures of the arm, that is, so long as it is an acute angle with the trunk of

the body, there cannot be any force applied at this place to occasion a luxation, since the joint is protected so well above.

The motions which the arm enjoys by this articulation, are to every side: and, by the succession of these different motions, a circle may be described. Besides which, the bone performs a small rotation round its own axis; but, when the axis of the bone is the centre of motion, the movements are very different from those which take place when the axis of its head is the centre; for the axis of the head forms a very large angle with the axis of the body of the bone. Thus, when the arm swings backwards and forwards, the axis of the head is the centre of motion: but when the elbow is bent, and the forearm forms a right angle with the os humeri, the motion which applies the forearm to the thorax, or removes it, is a rotation of this bone on its axis.

Though the motions of the arm seem to be very extensive, yet the larger share of them depends on the motions of the scapula; for the surface of the glenoid cavity is directed upwards or downwards, and, to a certain degree, backwards or forwards, to support the head of the os humeri. This is exemplified when we press the hand against a body which is before, or above, or to one side of us.

The lower end of the os humeri is articulated to the bones of the forearm, and carries them with it in all its motions; but serves as a base, on which they perform the motions peculiar to themselves; as will shortly be described.

The Forearm

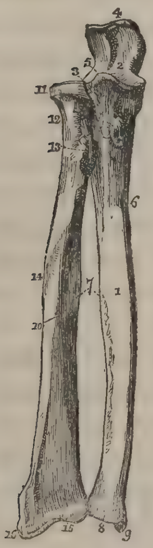
Consists of two bones, one of which is called *ulna*, from its being used as a measure, and the other *radius*, from the supposed resemblance to the spoke of a wheel.

These bones are concerned in very different operations. The ulna forms the elbow joint with the os humeri; the radius is the movable basis of the hand.

Ulna.

The length of this bone is equal to the forearm, of which it is a part. It is thickest above, and gradually diminishes until near its lower end. The body of the bone is nearly triangular in form. At the upper extremity of the ulna, on its anterior surface, is a semicircular notch. The end of the bone which forms the posterior part of this notch is denominated *olecranon*. The anterior part of the notch is formed by a process called coronoid. This notch applies to the pulley-like surface on the internal side of the lower extremity of the os humeri, to form the articulation of the elbow. In the middle of the concave surface is a ridge, in consequence of which, a small rocking motion is performed by the ulna. The external surface of the olecranon is rough, and strongly marked. The extensor muscle of the forearm is inserted into the end of it, and below this is a flat surface on which we lean. On the outside of

Fig. 41.*



the coronoid process is a semilunated smooth cavity, lined with cartilage; in which, and in a ligament extended from the one to the other end of this cavity, the round head of the radius plays. Immediately below it, a rough hollow gives lodging to the mucilaginous glands. Below the root of the coronoid process, this bone is scabrous and unequal, where the brachialis internus is inserted. On the outside of

* The two bones of the forearm seen from the front. 1. The shaft of the ulna. 2. The greater sigmoid notch. 3. The lesser sigmoid notch, with which the head of the radius is articulated. 4. The olecranon process. 5. The coronoid process. 6. The nutritious foramen. 7. The sharp ridges upon the two bones to which the interosseous membrane is attached. 8. The rounded head at the lower extremity of the ulna. 9. The styloid process. 10. The shaft of the radius. 11. Its head surrounded by the smooth border for articulation with the orbicular ligament. 12. The neck of the radius. 13. Its tuberosity. 14. The oblique line. 15. The lower extremity of the bone. 16. Its styloid process.

that, we observe a smooth concavity, where the beginning of the flexor digitorum profundus sprouts out.

The external angle of the triangular part of the ulna is very sharp, where the ligament that connects the two bones is fixed; the sides which make this angle are flat and rough, by the action and adhesion of the many muscles which are situated here. At the distance of one-third of the length of the ulna from the top, in its forepart, the passage of the medullary vessels may be seen slanting upwards. The internal side of the bone is smooth, somewhat convex, and the angles at each edge of it are blunted by the pressure of the muscles equally disposed about them.

As this bone descends, it becomes gradually smaller; so that its lower end terminates in a little head, standing on a small neck: towards the inner and back part of which last, an oblique ridge runs, that gives rise to the pronator radii quadratus. The head is sometimes cylindrical, smooth, and covered with a cartilage on its external side, to be received into the semilunar cavity of the radius; which a styloid process rises from its inside, to which is fixed a strong ligament that is extended to the os cuneiforme and pisiforme of the wrist. At the root of the process, the end of the bone is smooth, and covered with a cartilage. Between it and the bones of the wrist, a doubly concave movable cartilage is interposed; which is a continuation of the cartilage that covers the lower end of the radius, and is connected loosely to the root of the styloid process, and to the rough cavity there; in which mucilaginous glands* are lodged.

The ulna is principally concerned in the articulation with the os humeri, and forms a hinge-like joint, which allows extension nearly to a straight line, and flexion to an acute angle. By the sloping of the pulley-like surface, the lower part of the arm is turned outwards in the extension, and inwards in the flexion; which greatly facilitates the motion of the hand towards the head.

* All these so called glands are mere masses of adipose matter, supposed, though wrongly by Havers to be the glands which secrete the synovia.—P.

Radius.

Before the radius is described, it is necessary to observe that the lower end of this bone occasionally revolves half round the lower end of the ulna, and the hand with it. The relative situation of these parts is, therefore, different in different positions of the hand. In the following description, the palm of the hand is supposed to present forwards, and the thumb outwards; in which case, the two bones of the forearm will be parallel to each other.

The *radius* is situated on the outside of the forearm, and is rather shorter than the ulna. Its extremities are the reverse of those of the ulna in their proportionate size; and the body is not triangular, although it approaches towards that form. Its upper end is formed into a cylindrical head, which is hollowed on the top for an articulation with the tubercle at the side of the pulley of the os humeri; and the half cylindrical circumference next to the ulna is smooth, and covered with a cartilage, in order to be received into the semilunated cavity of that bone. Below the head, the radius is much smaller; and, therefore, this part is named its *cervix*. At the internal root of this neck is a flat tubercle, into the inner part of which the biceps flexor cubiti is inserted. From this a ridge runs downwards and outwards where the supinator radii brevis is inserted; and a little below, and behind this ridge, there is a rough scabrous surface, where the pronator radii teres is fixed.

The body of the radius is not straight, but curved externally the greater part of its length. Its external surface is rounded; the anterior and posterior surfaces are flattened; and between them is a sharp spine, to which the strong ligament extended between the two bones of the forearm is fixed. On the anterior surface, at a distance from its head, nearly equal to one-third the length of the bone, is the orifice of the canal for the medullary vessels, which has a direction obliquely upwards.

Towards the lower end the radius becomes broader and flatter, especially on its forepart, where the pronator quadratus muscle is situated. Its back part, at this end, has a flat strong ridge in the middle, and fossæ on each side. In a small groove,

immediately on the inside of the ridge, the tendon of the extensor of the last joint of the thumb plays. In a large one, inside of this, the tendons of the indicator, and of the common extensor muscles of the fingers pass. On the outside of the ridge there is a broad depression, which seems again subdivided, where the two tendons of the extensor carpi radialis are lodged. The external side of this end of the radius is also hollowed by the extensors of the first and second joints of the thumb. The ridges at the sides of the grooves, in which the tendons play, have an annular ligament fixed to them, by which the several sheaths for the tendons are formed. The forepart of this end of the radius is also depressed, where the flexors of the fingers and flexor carpi radialis pass. The internal side is formed into a semilunated smooth cavity, lined with a cartilage, for receiving the lower end of the ulna. The lowest part of the radius is formed into an oblong cavity; in the middle of which is a small transverse rising, gently hollowed, for lodging mucilaginous glands; while the rising itself is insinuated into the conjunction of the two bones of the wrist that are received into the cavity. The external side of this articulation is defended by a remarkable process of the radius, from which a ligament passes to the wrist; and this structure resembles that of the styloid process of the ulna with its ligament.

The ends of both the bones of the forearm being thicker than the middle, and the radius being curved, there is a considerable distance between the bodies of these bones; in the larger part of which a strong, tendinous, but thin ligament, is extended, to give a sufficient surface for the origin of the numerous fibres of the muscles situated here, that are so much sunk between the bones as to be protected from injuries, to which they would otherwise be exposed. But this ligament is wanting near the upper end of the forearm, where the supinator radii brevis and flexor digitorum profundus, are immediately connected.

As the head of the radius receives the tubercle of the os humeri, it is not only bended and extended along with the ulna, but may be moved almost half round its axis; and that this

motion round its axis may be sufficiently large, the ligament of the articulation is extended farther down than ordinary, on the neck of this bone, before it is connected to it; and it is very thin at its upper and lower part, but makes a firm ring in the middle. This bone is also joined to the ulna by a double articulation : for above, a tubercle of the radius plays in a socket of the ulna; whilst below, the radius gives the socket, and the ulna the tubercle. But then the motion performed at the two ends is very different : for, at the upper end, the radius does little more than turn round its axis; while, at the lower end, it moves nearly half round the cylindrical end of the ulna; and, as the hand is articulated and firmly connected here with the radius, they must move together. When the palm is turned uppermost, the radius is said to perform *supination :* when the back of the hand is above, it is said to be *prone.* But then the quickness and large extent of these two motions are assisted by the ulna, which, as was before observed, can move with a kind of small rotation on the sloping sides of the pulley. This rocking motion, though very inconsiderable in the elbow joint itself, is conspicuous at the lower end of such a long bone; and the strong ligament connecting this lower end to the carpus, makes the hand more readily obey these motions.

The Hand.

The *hand* comprehends the whole structure, from the end of the radius to the points of the fingers. Its back part is convex, for greater firmness and strength; and it is concave before, for containing more surely and conveniently such bodies as we take hold of. One half of the hand has an obscure motion in comparison of what the other has; it serves as a base to the movable half, which can be extended back very little farther than to a straight line with the forearm, but can be considerably bent forwards.

The *hand* consists of the *carpus* or wrist; *metacarpus*, or part adjoining the wrist; and the *fingers*, among which the thumb is reckoned.

Carpus.

No part of the skeleton is more complex than the carpus. The following description will, therefore, be of little use to a young student, unless the bones are before him when he is reading it. Great advantage will be derived from examining two sets of carpal bones: each set belonging to the same side. In one of these sets the bones should be connected by their natural ligaments; but the two rows separated from each other. The bones of the other set should be accurately cleaned, so that their forms and surfaces may be examined.

The *carpus* is composed of eight small bones, arranged in two rows; one of which rows is attached to the bones of the forearm, and the other to the body of the hand.

These bones are named from their figure, and shall be mentioned in the order in which they occur, beginning with the row next to the forearm; and with the external bone in each row.

They are, *Os Scaphoides*, *Lunare*, *Cuneiforme*, *Pisiforme*, forming the upper row; *Os Trapezium*, *Trapezoides*, *Magnum*, and *Unciforme*, forming the lower row.

First Row.

Os scaphoides is the largest of the eight, excepting one. It is convex above, concave and oblong below; from which small resemblance to a boat, it has got its name. Its smooth convex surface is divided by a rough middle fossa, which runs obliquely across it. The upper largest division is articulated with the radius. The common ligament of the joint of the wrist is fixed into the fossa; and the lower division is joined to the trapezium and trapezoides. The concavity receives more than half of the round head of the os magnum. The internal side of this hollow is formed into a semilunar plane to be articulated with the following bone. The external, posterior, and anterior edges are rough, for fixing the ligaments that connect it to the surrounding bones.

Os lunare has a smooth convex upper surface, by which it is articulated with the radius. The external side, which gives the name to the bone, is in the form of a crescent, and is joined with the scaphoid: the lower surface is hollow, for receiving part of the head of the os magnum. On the inside

Fig. 42.*

of this cavity is another smooth, but narrow, oblong sinuosity, for receiving the upper end of the unciforme: and on the inside of this a small convexity is found, for its connexion with the os cuneiforme. Between the great convexity above, and the first deep inferior cavity, there is a rough fossa, in which the circular ligament of the joint of the wrist is fixed.

Os cuneiforme is broader above and towards the back of the hand, than it is below and forwards; which gives it the resemblance of a wedge. The superior slightly convex surface is included in the joint of the wrist, being opposed to the lower end of the ulna. Below this the cuneiforme bone has a rough fossa, wherein the ligament of the articulation of the wrist is fixed. On the external side of this bone, where it is contiguous to the os lunare, it is smooth, and slightly concave. Its lower surface, where it is contiguous to the os unciforme, is oblong, somewhat spiral, and concave. Near the middle of its anterior surface, a circular plane appears, where the os pisiforme is sustained.

Os pisiforme is almost spherical, except one circular plane, or slightly hollowed surface, which is covered with cartilage for its motion on the cuneiforme bone, from which its whole

* A diagram showing the dorsal surface of the bones of the carpus, with their articulations.—The right hand. R. The lower end of the radius. U. The lower extremity of the ulna. F. The inter-articular fibro-cartilage attached to the styloid process of the ulna, and to the margin of the articular surface of the radius. S. The scaphoid bone: the numeral (5) indicates the number of bones with which it articulates. L. The semilunare articulating with five bones. C. The cuneiforme, articulating with three bones. P. The pisiforme, articulating with the cuneiforme only. T. The first bone of the second row—the trapezium, articulating with four bones. T. The second bone—the trapezoides, articulating also with four bones. M. The os magnum, articulating with seven. U. The unciforme, articulating with five. The numerals, 1, 3, 1, 2, 1, on the metacarpal bones, refer to the number of their articulations with the carpal bones.

rough body is prominent forwards into the palm; having the tendon of the flexor carpi ulnaris, and a ligament from the styloid process of the ulna fixed to its upper part; the transverse ligament of the wrist is connected to its external side: ligaments extended to the unciforme bone, and to the os metacarpi of the little finger, are attached to its lower part; the abductor minimi digiti has its origin from its forepart; and, at the external side of it, a small depression is formed for the passage of the ulnar nerve.

Second Row.

Os Trapezium has four unequal sides and angles in its back part, from which it has got its name. Above, its surface is smooth, slightly hollowed, and semicircular, for its conjunction with the os scaphoides. Its internal side is an oblong concave square, for receiving the following bone. The inferior surface is formed into a pulley, which faces obliquely outwards and downwards when the palm presents forward. On this pulley the first bone of the thumb is moved.

At the internal side of the pulley, a small oblong smooth surface is formed by the os metacarpi indicis. The forepart of the trapezium is prominent in the palm, and near to the internal side has a sinuosity in it, where the tendon of the flexor carpi radialis is lodged, on the ligamentous sheath of which the tendon of the flexor longus pollicis manus plays: near this the bone is scabrous, where the transverse ligament of the wrist is connected, the abductor and the flexor brevis pollicis have their origin, and ligaments go out to the first of the thumb.

Os trapezoides, so called from the irregular quadrangular figure of its back part, is the smallest bone of the wrist, except the pisiforme. The figure of it is an irregular cube. It has a small hollow surface above, by which it joins the scaphoides; a long convex one externally, where it is contiguous to the trapezium; a small internal concavity, for its conjunction with the os magnum; and an inferior convex surface, the edges of which are, however, so raised before and behind, that

a sort of pully is formed, where it sustains the os metacarpi indicis.

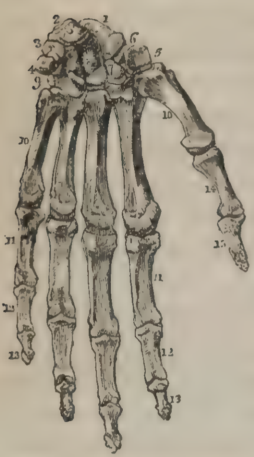
Os magnum, so called because it is the largest bone of the carpus, is oblong, having four quadrangular sides, with a round upper end, and a triangular plane one below. The round head is divided by a small rising, opposite to the connexion of the os scaphoides and lunare, which together form the cavity for receiving it. On the outside a short plane surface joins the os magnum to the trapezoides. On the inside is a long narrow concave surface where it is contiguous to the os unciforme. The lower end, which sustains the metacarpal bone of the middle finger, is triangular, slightly hollowed, and farther advanced on the external side than on the internal, having a considerable oblong depression made on the advanced outside by the metacarpal bone of the fore-finger; and generally there is a small mark of the os metacarpi digiti annularis on its internal side.

Os unciforme has got its name from a thin broad process that stands out from it forwards into the palm, and is hollow, for affording passage to the tendons of the flexors of the fingers. To this process, also, the transverse ligament is fixed that binds down, and defends these tendons; and the flexor and abductor muscles of the little finger have part of their origin from it. The upper plane surface is small, convex, and joined with the os lunare: the external side is long and slightly convex, adapted to the contiguous os magnum. The internal surface is oblique, and irregularly convex, to be articulated with the cuneiforme bone. The lower end is divided into two concave surfaces; the internal is joined with the metacarpal bone of the little finger; and the external one is fitted to the metacarpal bone of the ring finger.

The nature of the carpus will be best understood by studying the bones placed together, in their natural order, in the two rows.

When thus placed, they compose a structure of an oblong form, whose greatest length extends across the wrist, and forms a concavity in front, while it is convex posteriorly.

Fig. 43.*



Two bones of the first row, viz., the scaphoides and lunare, form an oblong convex surface, which has a transverse position with respect to the arm, and applies to the concave surface at the end of the radius. These surfaces are particularly calculated for flexion and extension, and also for a considerable motion to each side; and by a succession of these flexures, in different directions, the hand performs a circular motion, although it cannot perform at this joint a rotation, or revolution, on the axis of the carpus.

The under surface of the bones has a deep concavity, which is composed by the scaphoides, lunare and cuneiforme, and receives a prominence of the second row. It also presents a convex surface, formed by the scaphoides, which is received by the second row.

The upper surface of the second row, which is concerned in this articulation, is very irregular; it has a head formed by the magnum and unciforme, which penetrates deeply into the cavity of the first row. On the outside of this head the trapezium and trapezoides form a surface, which receives the projecting part of the scaphoides; so that the first row receives, and is received by the second, and the two surfaces are well calculated for moving, to a certain extent, in the way of flexion and extension, upon each other.

The lower surface of the second row, which is connected to

* The hand viewed upon its anterior or palmer aspect. 1. The scaphoid bone. 2. The semilunare. 3. The cuneiforme. 4. The pisiforme. 5. The trapezium. 6. The groove in the trapezium that lodges the tendon of the flexor carpi radialis. 7. The trapezoides. 8. The os magnum. 9. The unciforme. 10, 10. The five metacarpal bones. 11, 11. The first row of phalanges. 12, 12. The second row. 13, 13. The third row, or ungual phalanges. 14. The first phalanx of the thumb. 15. The second and last phalanx of the thumb.

the metacarpal bones, appears like the side of an arch, which is partly induced by the wedge-like form of the two bones in the centre; viz., the trapezoides, and the magnum. When the hand hangs by the side, and the palm is forward, all of this surface presents downwards, except that portion of it which is formed by the trapezium. This bone is placed obliquely between the two rows, and its surface for supporting the thumb presents obliquely downwards and outwards.

The trapezoides supports the fore-finger, the magnum the middle finger.

The scaphoides and the trapezium are very prominent at the external side of the anterior concave surface of the carpus; and the unciforme process, and the os pisiforme on the internal.

The Metacarpus,

Consists of four bones, which sustain the finger. Each bone is long and round, with its ends larger than its body. The upper end, which some call the base, is flat and oblong, inclining somewhat to the wedge-like form, without any considerable head or cavity; but it is, however, somewhat hollowed for the articulation with the carpus. It is made flat and smooth on the sides where these bones are contiguous to each other. Their bodies are flattened on the back part, particularly below the middle, by tendons of the extensors of the fingers. The anterior surface of these bodies is a little convex, especially in their middle; along which a sharp ridge stands out, separating the musculi interossei placed on each side of these bones, which are there made flat and plain by these muscles.

Their lower ends are raised into large oblong smooth heads, whose greatest extent is forwards from the axis of the bone. At the forepart of each side of the root of these heads, one or two tubercles stand out, for fixing the ligaments that go from one metacarpal bone to another, to preserve them from being drawn asunder. Around the heads a rough ring may be

remarked, for the capsular ligaments of the first joints of the fingers to be fixed to; and both sides of these heads are flat, by pressing on each other.

The *substance* of the metacarpal bones is the same with that of all long bones.

The metacarpal bones are *joined* above to the bones of the carpus, and to each other by surfaces almost flat. These connexions do not admit of much motion. The articulation of the round heads, at their lower ends, with the cavities of the first bones of the fingers, will soon be described.

The concavity on the forepart of the metacarpal bones, and the position of their bases on the arched carpus, cause them to form a hollow in the palm of the hand, which is often useful to us. The spaces between them lodge muscles, and their small motion makes them fit supporters for the fingers to play on.

Though the ossa metacarpi so far agree, yet they may be distinguished from each other by the following marks:

The *metacarpal bone of the fore-finger* is generally the longest. Its base, which is articulated with the os trapezoides, is hollow in the middle. The small ridge on the external side of this oblong cavity is smaller than the one opposite to it, and is made flat on the side by the trapezium. The internal ridge is also smooth, and flat on its ulnar side, for its conjunction with the os magnum; immediately below which, a semicircular smooth flat surface shows the articulation of this to the second metacarpal bone. The back part of this base is flattened where the long head of the extensor carpi radialis is inserted, and its forepart is prominent where the tendon of the flexor carpi radialis is fixed. The tubercle at the internal root of its head is larger than the external. Its base is so firmly fixed to the bone it is connected with, that it has no motion.

The *metacarpal bone of the middle finger* is generally the second in length; but often it is as long as the former: sometimes it is longer; and it frequently appears only to equal the first by the os magnum being farther projected downwards than any other bone of the wrist. Its base is a broad super-

ficial cavity, slanting inwards; the external posterior angle of which is so prominent, as to have the appearance of a process. The external side of this base is made plane in the same way as the external side of the former bone, while its internal side has two hollow circular surfaces, for joining the third metacarpal bone; and between these surfaces there is a rough fossa, for the adhesion of a ligament, and lodging mucilaginous glands. The extensor carpi radialis brevior is inserted into the back part of this base. The two sides of this bone are almost equally flattened; but the ridge on the forepart of the body inclines inwards. The tubercles at the forepart of the root of the head are equal. The motion of this bone is very little more than that of the former; and therefore these two firmly resist bodies pressed against them by the thumb or fingers, or both.

The *metacarpal bone of the ring finger* is shorter than the second metacarpal bone. Its base is semicircular and convex, for its conjunction with the os unciforme. On its external side are two smooth convexities, and a middle fossa, adapted to the second metacarpal bone. The internal side has a triangular smooth concave surface to join it with the fourth one. The anterior ridge of its body is situated more to the inside than to the outside. The tubercles near the head are equal. The motion of this third metacarpal bone is greater than the motion of the second.

The *metacarpal bone of the little finger* is the smallest and sharpest. Its base is irregularly convex, and rises slanting inwards. Its external side is exactly adapted to the third metacarpal bone. The internal has no smooth surface, because it is not contiguous to any other bone; but it is prominent where the extensor carpi ulnaris is inserted. As this metacarpal bone is furnished with a proper moving muscle, has the plainest articulation, is most loosely connected and least confined, it not only enjoys a much larger motion than any of the rest, but draws the third bone with it, when the palm of the hand is to be made hollow by its advancement forwards, and by the prominence of the thumb opposite to it.

Thumb and Fingers.

The *thumb* and *fore-fingers* are each composed of three bones.

The THUMB is situated obliquely in respect to the fingers; neither opposite directly to them, nor in the same plane with them. All its bones are much thicker and stronger in proportion to their length, than the bones of the fingers are; which is extremely necessary, as the thumb counteracts all the fingers.

The first bone of the thumb has its base adapted to the peculiar articulating surface of the trapezium: for, in viewing it from one side to the other, it appears convex in the middle; but, when viewed from behind forwards, it is concave there. The edge at the forepart of this base is extended farther than any other part; and round the back part of the base a rough fossa may be seen, for the connexion of the ligaments of this joint. The body and head of this bone are of the same shape as the ossa metacarpi; only that the body is shorter, the head flatter, and tubercles at the forepart of its root larger.

The articulation of the upper end of this bone is remarkable; for, though it has protuberances and depressions adapted to the double pulley of the trapezium, yet it enjoys a circular motion, as the joints do where a round head of the one plays in the orbicular socket of another; it is, however, more confined, and less expeditious, but stronger and more secure than such joints generally are.

The second bone of the thumb has a large base formed into an oblong cavity, whose greatest length is from one side to the other. Round it several tubercles may be remarked, for the insertion of ligaments. Its body is convex, or half round behind; but flat before, for lodging the tendon of the long flexor of the thumb, which is tied down by ligamentous sheaths, that are fixed on each side to the angle at the edge of this flat surface. The lower end of this second bone has two lateral round protuberances, and a middle cavity, whose greatest extent of smooth surface is forwards and backwards.

The articulation of the upper end of this second bone would seem calculated for motion in all directions; yet, on account of the strength of its lateral ligaments, the oblong figure of the joint itself, and mobility of the first joint, it only allows flexion and extension; and these are generally much confined.

The third bone of the thumb is the smallest, with a large base, whose greatest extent is from one side to the other. This base is formed into two cavities and a middle protuberance, to be adapted to the pulley of the former bone. This bone becomes gradually smaller, till near the lower end, where it is a little enlarged, and has an oval scabrous edge. Its body is rounded behind, but is flatter than in the former bone, for sustaining the nail. It is flat and rough before, by the insertion of the flexor longus pollicis.

The motion of this third bone is confined to flexion and extension.

The regular arrangement of the bones of the FINGERS in three rows, has obtained for them the name of the three *phalanges.* All of them have half round convex surfaces, covered with an aponeurosis, formed by the tendons of the extensors, lumbricales, and interossei, and placed directly backwards, for their greater strength; and their flat concave part is forwards, for taking hold more surely, and for lodging the tendons of the flexor muscles. The ligaments for keeping down these tendons are fixed to the angles that are between the convex and concave sides.

The bones of the first phalanx of the fingers answer to the description of the second bone of the thumb; only that the cavity in their base is not so oblong; nor is their motion on the metacarpal bones so much confined; for they can move laterally or circularly, the fore-finger in particular, but have no rotation, or a very small degree of it, round their axis.

The second bone of the fingers has its base formed into two lateral cavities, and a middle protuberance: while the lower end has two lateral protuberances, and a middle cavity: therefore, it is joined at both ends in the same manner; which none of the bones of the thumb are.

The third bone differs in nothing from the description of the third bone of the thumb, except in the general distinguishing marks; and, therefore, the second and third phalanx of the fingers enjoy only flexion and extension.

All the difference of the *phalanges* of the several fingers consists in their magnitude. The bones of the *middle finger* being the longest and largest; those of the *fore-finger* come next to these in thickness, but not in length, for those of the *ring finger* are a little longer. The *little finger* has the smallest bones. This disposition is the best contrivance for holding the largest bodies; because the longest fingers are applied to the middle largest periphery of such substances as are of a spherical figure.

The Inferior Extremities.

The inferior extremities consist of the THIGH, LEG, and FOOT.

The Thigh

Consists of one bone only; the *os femoris*, which is very strong, and larger than any other in the skeleton. It is nearly cylindrical in the middle, and slightly curved. The upper extremity is a spherical head, connected to the body of the bone by a neck. The lower extremity is much larger than the body, and is formed into two condyles.

The upper end of this bone is not continued in a straight line with the body of it, but the axis of it inclines obliquely inwards and upwards, whereby the distance between these two bones, at their upper part, is considerably increased. The head is the greater portion of a sphere. Towards its lower internal part, a round, rough spongy pit is observable, where the strong ligament, commonly, but inaccurately, called the *round one*, is fixed, to be extended from thence to the lower internal part of the receiving cavity, where it is considerably broader than near to the head of the thigh bone. The neck of the os femoris has a great many large holes, into which the fibres of the strong

ligament, continued from the capsular, enter, and are thereby firmly united to it; and round the root of the neck, where it rises from the bone, a rough ridge is found, where the capsular ligament of the articulation itself is connected. Below this root, a large unequal protuberance, called *trochanter major*, stands out; the external convex part of which is distinguished into three different surfaces; whereof the one on the upper and front part is scabrous and rough, for the insertion of the glutæus minimus; the superior one is smooth, and has the glutæus medius inserted into it; and the one behind is made flat and smooth, by the tendon of the glutæus maximus passing over it. The upper edge of this process is sharp and pointed at its back part, where the glutæus medius is fixed; but forwards it is more obtuse, and under it is a depression, into which some of the muscles, which rotate the thigh outwards, are fixed. From the posterior prominent part of this great trochanter, a rough ridge runs backwards and downwards, into which the quadratus is inserted. In the deep hollow, at the internal upper side of this ridge, the obturator externus is implanted. More internally, a conical process, called *trochanter minor*, rises, for the insertion of the musculus psoas and iliacus internus; and the pectineus is implanted into a rough hollow, below its internal root. The muscles inserted into these processes being the principal instruments of the

Fig. 44*

* The right femor, seen upon the anterior aspect. 1. The shaft. 2. The head. 3. The neck. 4. The great trochanter. 5. The anterior intertrochanteric line. 6. The lesser trochanter. 7. The external condyle. 8. The internal condyle. 9. The tuberosity for the attachment of the external lateral ligaments. 10. The groove for the tendon of origin of the popliteus muscle. 11. The tuberosity for the attachment of the internal lateral ligament.

rotary motion of the thigh, have occasioned the name of *trochanters* to be given to these processes.

The body of the os femoris is convex on the forepart and concave behind, which enables us to sit without leaning too much on the posterior muscles.

On the posterior concave surface is a broad rough ridge called *linea aspera,* which commences near the great trochanter, and continues downwards, more than two-thirds of the length of the bone, when it divides into two ridges, which descend towards each condyle. The internal of these ridges is the most smooth, and the space between them is nearly flat. Near the end of each of these ridges, a small, smooth-protuberance may often be remarked, where the two heads of the external gastrocnemius muscles take their rise; and from the forepart of the internal tubercle, a strong ligament is extended to the inside of the tibia.

The lower end of the os femoris is larger than any other part of it, and is formed into two great protuberances, one on each side, which are called its *condyles:* between them a considerable cavity is found, especially at the back part, in which the crural vessels and nerves lie. The internal condyle is longer than the external, which must happen from the oblique position of this bone, to give less obliquity to the leg. These processes are of an oblong form, and are placed obliquely with respect to each other; being in contact before and separated to a considerable distance behind.

They form in front a smooth pulley-like surface, the external side of which is highest, on which the patella moves.

Below, they are flat; and posteriorly, they are regularly convex.

Between these convex portions is a rough cavity, from which the crucial ligament arises, to be attached to the tibia. Round the lower end of the thigh bone, large holes are found, into which the ligaments for the security of the joint are fixed, and blood-vessels pass to the internal substance of the bone.

The thigh bone being articulated above with the acetabulum of the os innominatum, which affords its round head a secure and extensive play, can be moved to every side: but it is

restrained in its motion outwards by the high brims of the cavity, and by the round ligament; for otherwise the head of the bone would have been frequently thrust out at the breach of the brims on the inside, which allows the thigh to move considerably inwards. The body of this bone enjoys little or no rotary motion, though the head most commonly moves round its own axis; because the oblique direction of the neck and head from the bone, is such, that the rotary motion of the head can only bring the body of the bone forwards and backwards. Nor is the head, as in the arm, ever capable of being brought to a straight direction with its body; so far, however, as the head can move within the cavity backwards and forwards, the rest of the bone may have a partial rotation.

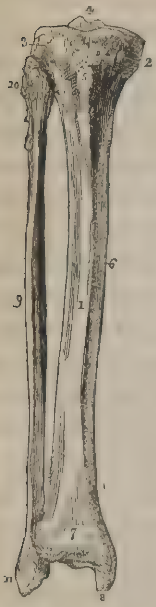
From the oblique position of these bones it results, that there is a considerable distance between them above, while the knees are almost contiguous. Sufficient space is thereby left for the external parts of generation, for the two great outlets of urine and fæces, and for the large thick muscles that move the thigh inwards. At the same time this situation of the thigh bone renders our progression quicker, surer, straighter, and in less room: for, had the knees been at a greater distance from each other, we must have been obliged to describe some part of a circle with the trunk of our body in making a long step; and when one leg was raised from the ground, our centre of gravity would have been too far from the base of the other, and we should consequently have been in danger of falling; so that our steps would neither have been straight nor firm, nor would it have been possible to walk in a narrow path, had our thigh bones been otherwise placed. In consequence, however, of the weight of the body bearing so obliquely on the joint of the knee by this situation of the thigh bones, weak rickety children become knock-kneed.

The Leg

Is composed of the two bones, the TIBIA and FIBULA.

The patella being evidently appropriated to the knee-joint, may be regarded as common both to the thigh and leg.

Fig. 45.*



The Tibia

Is the long thick triangular bone, situated at the internal part of the leg, and continued in almost a straight line from the thigh bone. The name is derived from its resemblance to the ancient musical instrument.

The upper end of the tibia is large, bulbous, and spongy. It has a horizontal surface, divided into two cavities, by a rough, irregular protuberance, which is hollow at its most prominent part, as well as before and behind. The anterior of the two ligaments that compose the great crucial is inserted into the middle cavity; and the depression behind receives the posterior ligament. The two broad cavities at the sides of this protuberance are not equal; for the internal is oblong and deep, to receive the internal condyle of the thigh bone; while the external is more superficial and round, for the external condyle. In each of these two cavities of a recent subject, a semilunar cartilage is placed, which is thick at its convex edge, and becomes gradually thinner towards the concave or interior edge. The thick convex edge of each cartilage is connected to the capsular and other ligaments of the articulation; but so near to their rise from the tibia, that the cartilages are not allowed to change their places; while their narrow ends are fixed at the insertion of the strong cross ligament into the tibia, and seem to have their substance united with it; therefore a circular hole is left between each cartilage and the ligament, in which the most prominent convex part of each

* The tibia and fibula of the right leg, articulated and seen from the front. 1. The shaft of the tibia. 2. The inner tuberosity. 3. The outer tuberosity. 4. The spinous process. 5. The tubercle. 6. The internal or subcutaneous surface of the shaft. 7. The lower extremity of the tibia. 8. The internal malleolus. 9. The shaft of the fibula. 10. Its upper extremity. 11. Its lower extremity, the external malleolus.

condyle of the thigh bone moves. The circumference of these cavities is rough and unequal, for the firm connexion of the ligaments of the joint. Immediately below the edge, at its back part, two rough flattened protuberances stand out; into the internal, the tendon of the semimembranosus muscle is inserted; and a part of the cross ligament is fixed to the external. On the outside of this last tubercle, a smooth slightly hollowed surface is formed by the action of the popliteus muscle.

Before the forepart of the upper end of the tibia, a large rough protuberance rises, to which the strong tendinous ligament of the patella is fixed. On the internal side of this, there is a broad scabrous slightly hollowed surface, to which the internal long ligament of the joint, the aponeurosis of the vastus internus, and the tendons of the semitendinous, gracilis, and sartorius, are fixed. Below the external edge of the upper end of the tibia, there is a flat circular surface, covered in a recent subject with cartilage, for the articulation of the fibula. The body of the tibia is triangular. The anterior angle is very sharp, and is commonly called the *spine* or *shin*. This ridge is not straight; but turns first inwards, then outwards, and lastly inwards again. The plane internal side is smooth and equal, being little subjected to the actions of muscle; but the external side is hollowed above by the tibialis anticus, and below by the extensor digitorum longus and extensor pollicis longus. The two angles behind these sides are rounded by the action of the muscles; the posterior side comprehended between them is not so broad as those already mentioned, but is more oblique and flattened by the action of the tibialis posticus and flexor digitorum longus. A little above the middle of the bone, the internal angle terminates, and the bone is made round by the pressure of the musculus soleus. Near to this, the passage of the medullary vessels is seen slanting obliquely downwards.

The lower end of the tibia is hollowed, with a small protuberance in the middle. The internal side of this cavity, which is smooth, and in a recent subject is covered with cartilage, is

extended into a considerable process, commonly named *malleolus internus;* the point of which is divided by a notch, and from it ligaments are sent out to the foot. The external side of this end of the tibia has a rough irregular cavity formed in it, for receiving the lower end of the fibula. The posterior side has two lateral grooves, and a small middle protuberance. In the internal depression, the tendons of the musculus tibialis posticis and flexor digitorum longus are lodged; and in the external, the tendon of the flexor longus pollicis plays. From the middle protuberance, ligamentous sheaths go out, for tying down these tendons.

The Fibula

Is the small bone, placed on the outside of the leg, opposite to the external angle of the tibia; the shape of it is irregular.

The head of the fibula has a circular surface formed on its inside, which, in a recent subject is covered with a cartilage; and it is so closely connected to the tibia by ligaments, as to allow only a very small motion backwards and forwards. This head is protuberant and rough on its outside, where a strong round ligament and the musculus biceps are inserted, and, below the back part of its internal side, a tubercle may be remarked, that gives rise to the strong tendinous part of the soleus muscle.

The body of this bone is a little crooked inwards and backwards: which figure is owing to the actions of the muscles. The sharpest angle of the fibula is forwards; on each side of which the bone is considerably, but unequally, depressed by the bellies of the several muscles that rise from or act upon it. The external surface of the fibula is depressed obliquely from above downwards and backwards, by the two peronæi. Its internal surface is unequally divided into two narrow longitudinal planes, by an oblique ridge extended from the upper part of the anterior angle. To this ridge the ligament stretched between the two bones of the leg is connected. The anterior of the two planes is very narrow above, where the extensor longus digitorum and extensor longus pollicis arise from it: but is

broader below, where it has the print of the peroneus tertius. The posterior plane is broad and hollow, giving origin to the larger share of the tibialis posticus. The internal angle of this bone has a tendinous membrane fixed to it, from which some fibres of the flexor digitorum longus take their rise. The posterior surface of the fibula is the plainest and smoothest; but is made flat above by the solæus, and is hollowed below by the flexor pollicis longus. In the middle of this surface, the canal for the medullary vessels may be seen slanting downwards.

The lower end of the fibula is extended into a spongy oblong head: on the inside of which is a convex, irregular, and frequently a scabrous surface, that is received by the external hollow of the tibia, and so firmly joined to it by a very thin intermediate cartilage and strong ligaments, that it scarce can move. Below this the fibula is stretched out into a smooth coronoid process, covered with cartilage on its internal side, and is there contiguous to the outside of the first bone of the foot, the astragalus, to secure the articulation. This process, named *malleolus externus*, being situated farther back than is the internal malleolus, and in an oblique direction, obliges us, naturally, to turn the forepart of the foot outwards. At the lower internal part of this process, a spongy cavity for mucilaginous glands may be remarked; from its point, ligaments are extended to the bones of the foot, viz. the astragalus, os calcis, and os naviculare; and from its inside, short strong ones go out to the astragalus. On the back part of it a sinuosity is made by the tendons of the peronei muscles. When the ligament, extended over these tendons from the one side of the depression to the other, is broken, stretched too much, or made weak by the sprain, the tendons frequently start forwards to the outside of the fibula.

The conjunction of the upper end of the fibula with the tibia is by plain surfaces tipped with cartilage; and at its lower end the cartilage seems to glue the two bones together; not, however, so firmly in young people, but that the motion at the other end is very observable. In old subjects, the two bones

of the leg are sometimes united by anchylosis at their lower ends.

The principal use of this bone is to afford origin and insertion to muscles; and to give a particular direction to their tendons. It likewise assists to make the articulation of the foot more secure and firm, and to complete the hinge-like joint at the ankle. The ends of the tibia and fibula being larger than their middle, a space is here left, which is filled up with a ligament similar to that which is extended between the bones of the forearm; and which is also discontinued at its upper part, where the tibialis anticus immediately adheres to the solæus and tibialis posticus; but every where else it gives origin to muscular fibres.

The Patella or Rotula

Is a small flat bone situated at the forepart of the joint of the knee. Its shape resembles the common figure of the heart with its point downwards. The anterior convex surface of the rotula is pierced by a great number of holes, into which are inserted the fibres of the strong ligament that is spread over it. Its posterior surface is smooth, covered with a cartilage, and divided by a middle convex ridge into two cavities, of which the external is largest; and both are exactly adapted to the pulley of the os femoris, on which they are placed in the most ordinary unstraining postures of the legs: but, when the leg is much bent, the patella descends far down on the condyles; and when the leg is fully extended, the patella rises higher in its upper part than the pulley of the thigh bone. The plane smooth surface is surrounded by a rough prominent edge, to which the capsular ligament adheres. Below, the point of the bone is scabrous, where the strong tendinous ligament from the tubercle of the tibia is fixed. The upper horizontal part of this bone is flattened and unequal where the tendons of the extensors of the leg are inserted.

The substance of the patella is cellular, with very thin firm external plates; but then these cells are so small and such a quantity of bone is employed in their formation, that scarce

any bone of its bulk is so strong. But, notwithstanding this strength, it is sometimes broken by the violent straining effort of the muscles.

The principal motions of the knee joint are flexion and extension. In the former of these, the leg may be brought to a very acute angle with the thigh, by the condyles of the thigh bones being round, and made smooth far backwards. In performing this, the patella is pulled down by the tibia. When the leg is to be extended, the patella is drawn upwards, consequently, the tibia forwards, by the extensor muscles; which, by means of the protuberent joint, and of this thick bone with its ligament, have the chord, with which they act, fixed to the tibia at a considerable angle, and act, on that account, with advantage ; but they are restrained from pulling the leg farther than to a straight line with the thigh, by the posterior part of the cross ligament, that the body might be supported by a firm perpendicular column : for, at this time, the thigh and leg are as little movable in a rotary way, or to either side, as if they were one continued bone. But, when the joint is a little bent, the rotula is not tightly braced, and the posterior ligament is relaxed ; therefore, this bone may be moved a little to either side, or with a small rotation in the superficial cavities of the tibia ; which is done by the motion of the external cavity backwards and forwards, the internal serving as a sort of axis. Seeing, then, one part of the cross ligament is situated perpendicularly, and the posterior part is stretched obliquely from the internal condyle of the thigh outwards, that posterior part of the cross ligament prevents the leg from being turned much inwards; but it could not hinder it from turning outwards almost round, were not that motion confined by the lateral ligaments of this joint, which can yield little.

This rotation of the leg outwards is of great advantage to us in crossing our legs, and turning our feet outwards, on several necessary occasions; though it is necessary that this motion should not be very large, to prevent frequent luxations here. While all these motions are performing, the part of the tibia that moves immediately on the condyles is that which is within

the cartilaginous rings, which, by the thickness on their outsides, make the cavities of the tibia more horizontal, by raising their external side where the surface of the tibia slants downwards. By these means the motions of this joint are more equal and steady than otherwise they would have been. The cartilages being capable of changing a little their situation, contribute to the different motions and postures of the limb, and, likewise, make the motions larger and quicker.

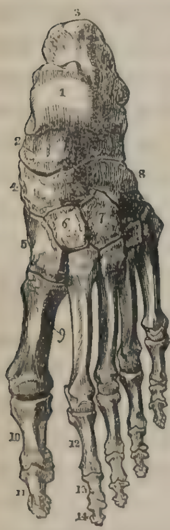
The Foot.

The foot is divided into the *tarsus*, *metatarsus*, and *toes*.

The sole of the foot is necessarily described as the inferior part, and the side of the great toe as the internal.

Tarsus.

Fig. 46.*



The *tarsus* consists of seven spongy bones; to wit, the *astragalus, os calcis, naviculare, cuboides, cuneiforme externum, cuneiforme medium* and *cuneiforme internum.*

The *astragalus* is the uppermost of these bones. The *os calcis* is below the astragalus, and forms the heel. The *os naviculare* is in the middle of the internal sides of the tarsus. The *os cuboides* is the most external of the row of four bones, at its forepart. The *os cuneiforme externum* is placed at the inside of the cuboid. The *cuneiforme medium* is between the external and internal cuneiforme bones; and the *internal cuneiforme* is at the internal side of the foot.

The upper part of the *astragalus* is formed

* The dorsal surface of the left foot. 1. The astragalus; its superior quadrilateral articular surface. 2. The anterior extremity of the astragalus, which articulates with (4.) the scaphoid bone. 3. The os calcis. 4. The scaphoid bone. 5. The internal cuneiform bone. 6. The middle cuneiform bone. 7. The external cuneiform bone. 8. The cuboid bone. 9. The metatarsal bones of the first and second toes. 10. The first phalanx of the great toe. 11. The second phalanx of the great toe. 12. The first phalanx of the second toe. 13. Its second phalanx. 14. Its third phalanx.

into a large smooth head, which is slightly hollowed in the middle; and therefore resembles a superficial pulley, by which it is fitted to the lower end of the tibia. The internal side of this head is flat and smooth, to play on the internal malleolus. The external side has also such a surface, but larger, for its articulation with the external malleolus. Round the base of this head there is a rough fossa; and immediately before the head, as also below its internal smooth surface, we find a considerable rough cavity.

The lower surface of the astragalus is divided by an irregular deep rough fossa, which, at its internal end, is narrow, but gradually widens as it stretches obliquely outwards and forwards. The smooth surface, covered with cartilage, behind this fossa, is large, oblong, extended in the same oblique situation with the fossa, and concave for its conjunction with the os calcis. The posterior edge of this cavity is formed by two sharp-pointed rough processes, between which is a depression made by the tendon of the flexor pollicis longus. The lower surface before the fossa is convex, and composed of three distinct smooth planes. The long one behind, and the exterior or shortest, are articulated with the heel bone; while the internal, which is the most convex of the three, rests and moves upon a cartilaginous ligament, that is continued from the os calcis to the os naviculare, without which ligament the astragalus could not be sustained, but would be pressed out of its place by the great weight it supports; and the other bones of the tarsus would be separated. Nor would a bone be fit here, because it must have been thicker than could conveniently be allowed; otherwise it would break, and would not prove such an easy bending base, to lessen the shock which is given to the body, in leaping, running, &c.

The forepart of this bone is formed into a convex oblong smooth head, which is received by the os naviculare, and is placed obliquely; its longest axis inclining downwards and inwards. Round the root of this head, especially on the upper surface, a rough fossa may be remarked.

The astragalus is articulated above to the tibia and fibula, which together form one cavity. In this articulation, flexion

and extension are the most considerable motions; the other motions being restrained by the malleoli, and by the strong ligaments which go out from the points of these processes, to the astragalus and os calcis. When the root is bent, as it commonly is when we stand, no lateral or rotary motion is allowed in this joint; for then the head of the astragalus is sunk deep between the malleoli, and the ligaments are tense: but when the foot is extended, the astragalus can move a little to either side, and with a small rotation. By this contrivance, the foot is firm, when the weight of the body is to be supported on it; and, when a foot is raised, we are at liberty to direct it more exactly to the place we intend next to step upon.

The astragalus is joined below to the os calcis; and before to the os naviculare, in the manner to be explained when these bones are described.

The *os calcis* is the largest bone of the seven. Behind, it is formed into a large knob, commonly called the *heel*, the posterior surface of which is rough below for the insertion of what is called the tendo-achillis, and oblique above to allow the heel to be depressed without pressing against the tendon. On the upper surface of the os calcis, there is an irregular oblong smooth convexity, adapted to the concavity at the back part of the astragalus; and beyond this a narrow fossa is seen, which divides it from two small concave smooth surfaces, that are joined to the forepart of the astragalus. The posterior of these smooth surfaces, which is the largest, is the upper surface of a process which projects inwards: and under it is a small sinuosity for the tendon of the flexor digitorum longus.

The external side of this bone is flat, with a superficial fossa running horizontally, in which the tendon of the musculus peroneus longus is lodged. The internal side of the heel bone is hollowed, for lodging the origin of the massa carnea, and for the safe passage of tendons, nerves, and arteries. Under the side of the internal smooth concavity, a particular groove is made by the tendon of the flexor pollicis longus; and from the thin protuberance of this internal side a cartilaginous ligament that supports the astragalus, goes out to the os naviculare; on

which ligament, and on the edge of this bone to which it is fixed, the groove is formed for the tendon of the flexor digitorum profundus.

The lower surface of this bone is flat at the back part, and immediately before this plane, there are two tubercles, from the internal of which the musculus abductor pollicis, flexor digitorum sublimis, as also part of the aponeurosis plantaris, and of the abductor minimi digiti, have their origin; and the other part of the abductor minimi digiti and aponeurosis plantaris rises from the external. Before these protuberances, this bone is concave, for lodging the flexor muscles; and, at its forepart, we may observe a rough depression, from which, and a tubercle behind it, the ligament goes out that prevents this bone from being separated from the os cuboides.

The forepart of the os calcis is formed into an oblong pulley-like smooth surface, which is circular at its upper external end, but is pointed below. The smooth surface is fitted to the os cuboides.

Though the surfaces by which the astragalus and os calcis are articulated, seem fit enough for motion, yet the very strong ligaments, by which these bones are connected, prevent much motion, and give firmness to this principal part of our base, which rests on the ground.

Os naviculare is somewhat oval. It is formed into an oblong concavity behind, for receiving the anterior head of the astragalus. The upper surface is convex. Below, the surface is very unequal and rough; but hollow for the safety of the muscles. Its internal extremity is very prominent. The abductor pollicis takes in part its origin from it, the tendon of the tibialis posticus is inserted into it, and to it two remarkable ligaments are fixed; the first is the strong one, formerly mentioned, which supports the astragalus; the second is stretched from this bone obliquely across the foot, to the metatarsal bones of the middle toe, and of the toe next to the little one. On the outside of the os naviculare there is a semicircular smooth surface, where it is joined to the os cuboides. The forepart of this bone is covered with cartilage, and divided into three smooth planes, fitted to the three ossa cuneiformia.

The os naviculare and astragalus are joined as a ball and socket; and the naviculare moves in several directions in turning the toes inwards, or in raising or depressing either side of the foot, though the motions are greatly restrained by the ligaments which connect this to the other bones of the tarsus.

Os Cuboides is an irregular cube. Behind, it is formed into an oblong unequal cavity, adapted to the forepart of the os calcis. On its internal side, there is a small semicircular smooth cavity, to join the os naviculare. Immediately before which, an oblong smooth plane is made by the os cuneiforme externum; below this the bone is hollow and rough. On the internal side of the lower surface, a round protuberance and fossa are found, where the musculus abductor pollicis has its origin. On the external side of this surface, there is a broad ridge running forwards and inwards, covered with cartilage; immediately before which a smooth fossa may be observed, in which the tendon of the peroneus primus runs obliquely across the foot. Before, the surface of the os cuboides is flat, smooth, and slightly divided into two planes, for sustaining the os metatarsi of the little toe, and of the toe next to it.

The form of the back part of the os cuboides, and the ligaments connecting the joint with the os calcis, both concur in allowing little motion in this part.

Os cuneiforme externum is shaped like a wedge, being broad and flat above, with long sides running obliquely downwards, and terminating in an edge. The upper surface of this bone is an oblong square. The one behind is nearly a triangle, but not complete at the inferior angle, and is joined to the os naviculare. The external side is an oblong square divided as it were by a diagonal; the upper half of it is smooth, for its conjunction with the os cuboides: the other is a scabrous hollow, with a small smooth impression made by the os metatarsi of the toe next to the little one. The internal side of this bone is flattened before by the metatarsal bone of the toe next to the great one, and the back part is also flat and smooth where the os cuneiforme medium is contiguous to it. The forepart of this bone is triangular, for sustaining the os metatarsi of the middle toe.

Os cuneiforme, or *minimum*, is still more exactly the shape of a wedge than the former. Its upper part is square; its internal side has a flat smooth surface for its connexion with the adjoining bone; the external side is smooth and a little hollowed, where it is contiguous to the last described bone. Behind, this bone is triangular, where it is articulated with the os naviculare; and it is also triangular at its forepart, where it is contiguous to the os metatarsi of the toe next to the great one.

The broad thick part of the *os cuneiforme maximum*, or *internum*, is placed below, and the small thinner edge is above. The surface of the os cuneiforme behind, where it is joined to the os naviculare, is hollow, smooth, and of a circular figure below, but pointed above. The external side consists of two smooth and flat surfaces. With the posterior, that runs obliquely forwards and outwards, the os cuneiforme minimum is joined; and with the anterior, whose direction is longitudinal, the os metatarsi of the toe next to the great one is connected. The forepart of this bone is flat and smooth, for sustaining the os metatarsi of the great toe. The internal side is scabrous, with two remarkable tubercles below, from which the musculus abductor pollicis rises, and the tibialis anticus is inserted into its upper part.

The three cuneiforme bones are all so secured by ligaments, that very little motion is allowed in any of them.

These seven bones of the *tarsus*, when joined, are convex above, and leave a concavity below, for lodging safely the several muscles, tendons, vessels, and nerves, that lie in the sole of the foot. In the recent subject, their upper and lower surfaces are covered with strong ligaments, which adhere firmly to them; and all the bones are so tightly connected by these and the other ligaments, which are fixed to the rough ridges and fossæ, that notwithstanding the many surfaces covered with cartilage, some of which are of the form of the very movable articulations, no more motion is here allowed, than is necessary to prevent too great a shock of the fabric of the body in walking, leaping, &c., by falling on too solid a base. If the tarsus was one continued bone, it would likewise be

much more liable to be broken, and the foot could not accommodate itself to the surfaces we tread on by becoming more or less hollow, or by raising or depressing either of its sides.

Metatarsus.

The *Metatarsus* is composed of five bones, which agree, in their general characters, with the metacarpal bones; but may be distinguished from them by the following marks: 1. They are longer, thicker, and stronger. 2. Their anterior round ends are not so broad, and are less in proportion to their basis. 3. Their bodies are sharper above and flatter on their sides, with their inferior ridge inclined more to the outside. 4. The tubercles at the lower part of the round head are larger.

Fig. 47.*

The first or internal metatarsal bone is easily distinguished from the rest by its thickness. The one next to it is the longest, and with its sharp edge almost perpendicular. The others are shorter and more oblique, as their situation is more external. Which general remarks, with the description now to be given of each, may teach us to distinguish them from each other.

Os metatarsi pollicis is by far the thickest and strongest, as having much the greatest weight to sustain. Its base is oblong, irregularly concave, and of a semilunar figure, to be adapted to the os cuneiforme maximum. The inferior edge of this base is a little prominent and rough,

* The sole of the left foot. 1. The inner tuberosity of the os calcis. 2. The outer tuberosity. 3. The groove for the tendon of the flexor longus digitorum. 4. The rounded head of the astragalus. 5. The scaphoid bone. 6. Its tuberosity. 7. The internal cuneiform bone; its broad extremity. 8. The middle cuneiform bone. 9. The external cuneiform bone. 10, 11. The cuboid bone. 11. Refers to the groove for the tendon of the peroneus longus. 12, 12. The metatarsal bones. 13, 13. The first phalanges. 14, 14. The second phalanges of the four lesser toes. 15, 15. The third, or ungual phalanges of the four lesser toes. 16. The last phalanx of the great toe.

where the tendon of the peroneus primus muscle is inserted. On its outside, an oblique circular depression is made by the second metatarsal bone. Its round head has generally on its forepart a middle ridge, and two oblong cavities, for the ossa sesamoidea; and, on the external side, a depression is made by the following bone.

Os metatarsi of the *second toe* is the longest of the five, with a triangular base supported by the os cuneiforme medium, and the external side produced into a process; the end of which is an oblique smooth plane, joined to the os cuneiforme externum. Near the internal edge of the base, this bone has two small depressions, made by the os cuneiforme maximum, between which is a rough cavity. Farther forwards we may observe a smooth protuberance, which is joined to a foregoing bone. On the outside of the base are two oblong smooth surfaces for its articulation with the following bone; the superior smooth surface being extended longitudinally, and the inferior perpendicularly, between which there is a rough fossa.

Os metatarsi of the *middle toe* is the second in length. Its base, supported by the os cuneiforme externum, is triangular, but slanting outwards, where it ends in a sharp-pointed little process, and the angle below it is not completed.

The internal side of this base is best adapted to the preceding bone; and the external side has also two smooth surfaces covered with cartilage, but of a different figure; for the upper one is concave, and being round behind, turns smaller as it advances forwards; and the lower surface is a little smooth, convex, and very near the edge of the base.

Os metatarsi of the *fourth toe* is nearly as long as the former, with a triangular slanting base joined to the os cuboides, and made round at its external angle; having one hollow smooth surface on the outside, where it is pressed upon by the following bone; and two on the internal side, corresponding to the former bone, behind which is a long narrow surface impressed by the os cuneiforme externum.

Os metatarsi of the *little toe* is the shortest, situated with its two flat sides above and below, and with the ridges laterally.

The base of it, part of which rests on the os cuboides, is very large, tuberous, and produced into a long-pointed process externally, where part of the abductor minimi digiti is fixed; and into its upper part the peroneus secundus is inserted. Its inside has a flat conoidal surface, where it is contiguous to the preceding bone.

When we stand, the fore ends of these metatarsal bones, and the os calcis, are our only supporters, and, therefore, it is necessary that they should be strong, and should have a confined motion.

The Toes.

The bones of the toes are nearly similar to those of the thumb and fingers; particularly the two of the great toe, which are precisely formed as the two last of the thumb; but their position, as respects the other toes, is not oblique; and they are proportionally much stronger, because they are subjected to a greater force; for they sustain the impulse by which our bodies are pushed forwards by the foot behind at every step we make; and on them principally the weight of the body is supported, when we are raised on our tip-toes.

The three bones in each of the other four toes, compared with those of the fingers, differ from them in these particulars. They are less, and smaller in proportion to their lengths. Their basis are much larger than their anterior ends. The first phalanx is proportionally much longer than the bones of the second and third, which are very short.

The toe next to the great one has the largest bones in all dimensions, and the bones of the other toes diminish according to the order of their position; those of the exterior being least.

The General Structure of the Foot.

The *foot* may be considered as an arch, of which the back part of the heel, and the anterior extremities of the metatarsal bones and the toes, are the abutments. The heel, or posterior abutment is not so broad as the anterior, and is placed on the outside and not in the middle of the extremity of the arch. The

process on the inside of the os calcis, which supports the astragalus, increases the breadth of the arch; and the os naviculare completes it. The arch, thus constructed, does not appear very firm, and this apparent want of strength seems increased by the position of the anterior portion of the astragalus, a part of which is between the os calcis and os naviculare, and not supported by either. These bones, however, are firmly connected by ligaments, and one which passes from the os calcis to the os naviculare, under the forepart of the astragalus, gives effectual support to that bone.

The outside of the foot, formed by the os calcis, os cuboides, and the lesser metatarsal bone, does not partake much of the nature of an arch; for it is almost flat. As the internal side forms a considerable arch, the foot is to be considered as possessing a double convexity, viz. transversely, as well as longitudinally.

The great toe, from its internal situation, is the principal anterior abutment of the arch on the internal side of the foot; hence its great importance.

The astragalus, which is the basis of the tibia, and of course pressed by half of the weight of the body when we stand, appears to be in a situation which is very oblique, and imperfectly supported; and accordingly it has been completely forced from its position, by accidents in which the leg has been twisted or turned inward, and the foot prevented from turning with it. It is probable that this misfortune would often take place if the fibula did not previously yield, as in some of the cases of fracture of that bone near the external ankle.

One great object of this peculiar structure is, that the foot may yield in cases of violent and sudden pressure, as when we jump or fall upon the feet. The safety of the foot, and the facility of its ordinary movement, are not the only objects of its peculiar structure, but concussion of the whole body, and particularly of the brain, is thereby avoided to a certain degree.

This may be inferred from the fact that many persons suffer

violent concussions, in consequence of falling upon other parts of the body, who are free from these effects when they fall upon the feet.

The Sesamoid Bones

Are seldom larger than half a pea. They are most commonly found at the second joint of the thumb, and of the great toe; and are placed in pairs, especially at the great toe, between the tendons of the flexor muscles and the bones. In these situations they are convex externally, and on their internal surfaces they are concave and covered with cartilage.

They are also sometimes found between the heads of the gastrocnemius muscle and the condyles of the os femoris.

In the joints of the thumb and toe they appear to be very analogous to the patella.

—Besides the four pair of sesamoid bones above described as belonging to the skeleton, viz. two upon the metacarpo-phalangeal articulation of each thumb, and two upon the corresponding joint of each great toe, there is often found in addition, one upon the metacarpo-phalangeal joint of the little finger, and upon the corresponding joint in the foot. There is one also often met with in the tendon of the peroneus longus muscle, where it glides through the groove in the cuboid bone. Sometimes they are found in the tendons that wind round the inner and outer malleolus and in the psoas and iliacus where they glide over the body of the os pubis.—

The Extremities of the Fœtus.

In the upper extremity the clavicle is almost perfect at birth; but the acromion and coronoid processes of the scapula, as well as the head, are in a cartilaginous state.

Both ends of the os humeri are cartilaginous. They afterwards ossify in the form of epiphyses, and are united to the body of the bone.

The two bones of the forearm are in the same situation.

There are no bones of the carpus; but in their situation is an equal number of cartilages, which resemble them exactly.

These cartilages are separated from each other, by synovia membranes, as the bones afterwards are. Each of them ossifies from a single point, except the unciforme.

The metacarpal bones, and the first bone of the thumb have cartilages at each extremity, which afterwards become epiphysis.

The bones of the phalanges are likewise cartilaginous at each extremity. The extremities next to the hand are epiphyses; but it is probable that the other extremities ossify gradually from their centres.*

In the lower extremity, the head and neck, and two trochanters of the os femoris are cartilaginous and form three epiphyses.

The other end of this bone is also cartilaginous, and constitutes but one epiphysis, notwithstanding its size; the ossification commencing in the centre.

At birth, the body of the os femoris is less curved than it becomes afterwards; and the angle formed by the neck of the bone is less obtuse than in the adult.

The patella is entirely cartilaginous at birth.

The two extremities of the tibia and fibula are also cartilaginous, and become epiphyses.

The astragalus and os calcis are somewhat ossified within, and have a large portion of cartilage exteriorly.

In place of the other bones of the tarsus there are cartilages of their precise shape, which are as distinct from each other as the future bones are.

The state of the metatarsal bones, and the phalanges of the toes, resembles that of the bones of the hand.†

* See Nesbit's Osteology, page 126.

† Volehn Koyter, a disciple of Fallopius, has given to the profession one of the best accounts of Osteogeny, according to Lassus.—H.

PART II.

SYNDESMOLOGY.

CHAPTER III.

GENERAL ANATOMY OF THE LIGAMENTOUS, FIBROUS, OR DESMOID TISSUE.

Of the ligaments and membranes which connect the different parts of the body to each other—Of the articular cartilage—Fibro-cartilages—Synovial capsules, and particular articulations.

The tendons and the strong membranes connected with them called aponeuroses, the fascia which bind down some of the muscles and afford an origin to many of their fibres, and the membranes which confine the tendons, appear to be composed of the same substance.

—Notwithstanding some slight shades of difference which exist in the physical and chemical composition of these different parts, they are all now included with the periosteum, perichondrium, dura mater, sclerotic coat of the eye, &c., under the general head of *ligamentous*, *fibrous*, or *desmoid tissue.** This tissue is sometimes called, from the whiteness of its appearance, the *albugineous tissue.* It is spread very generally throughout the body, and is found wherever extraordinary strength and resistance is required, without elasticity or muscular contraction. It has been called ligamentous or desmoid, from its fastening together the bones and cartilages, as in the ligaments proper, and from binding down the muscles so as to preserve the symmetry of the limbs, in the form of fascia and

* The term ligament is frequently, though not with exact propriety applied to the duplicatures of serous membranes, which are attached to and assist in supporting different viscera, as the liver, bladder, uterus, &c., since these doubtless do not belong to the fibrous or desmoid tissue.—P.

aponeurosis, and from fastening the tendons in their grooves in the form of their theca's or sheaths. The term fibrous was applied to it by Bichat, (though its elements are dissimilar to muscular fibre,) in consequence of its performing the office of bands or chords, and being composed essentially of firm inelastic threads, or albuminous fibres. These fibres crossing each other in various directions and woven densely together, with some intervening cellular tissue, form the aponeuroses, fasciæ, sheaths, articular capsules, periosteum, dura mater, and tunica albuginea ; arranged longitudinally, they form the tendons of the muscles and the straight ligaments of the joints. The tendons, by a little dissection, may be spread out into a membrane, and in some parts of the body we see them naturally unfolding themselves to form an aponeurosis.

—Between all these different parts there is more or less connexion. The tendons are inserted upon the bones only through the intermedium of the periosteum, by which the bones are covered. The aponeuroses are connected with the periosteum by the fasciæ which they send down between the muscles. The ligaments and periosteum are directly continuous, and the dura mater, as it sends out processes around the nerves, becomes continuous with the periosteum that lines the foramina of the bones, through which the nerves pass. Bichat, considered the pesiosteum the source and centre of this system; Bonn, of Amsterdam, as well as Clarus, believed the aponeuroses investing the limbs to be the centre ;—an opinion more venerable than either of these, that of the Arabian anatomists, fixed it in the dura mater. But, in truth there is no proper centre. In many parts, there is a fibrous tissue isolated from the rest, as the investing coat of the spleen and kidneys, and the fibrous portion of the pericardium.

—The fibrous tissue in all parts of the body is continuous, at its surfaces and margins, with the common cellular tissue, and in many parts we find it, especially in the aponeuroses and fasciæ, degenerating insensibly into it. There appears in fact to be a close relationship between these two tissues; in its developement in the fœtus, it first appears as a soft, flexible,

extensible, homogeneous tissue, resembling much the cellular, and presents no appearance of fibres, till near the period of birth. As life advances it becomes more hard, solid and yellow, and in extreme old age presents much rigidity, and is occasionally even converted into bone. When macerated in water, or imbued with fluids, as in scrofulous inflammation of the joints, it presents a pulpy, spongy appearance, in the cells of which the fluid is contained. If the maceration is carried only to a limited extent, the fibres will separate into filaments, as delicate as those of the silk worm; but by prolonged maceration these filaments themselves disappear in the cellular mass. Mascagni, believed these fibres were lymphatics enclosed in a vascular web. Beclard, that they were nothing but condensed cellular tissue. Isenflam, that it was cellular tissue, with the walls imbued and the cells filled with gluten and albumen, and more or less in the advance of life with earthy matter; an opinion which seems to accord with the different phases which the tissue presents. Chaussier and Bichat, considered the fibre as primitive and peculiar, and that maceration only brought into view the cellular tissue which connected the fibres together.

—However this may be, and it is a question not yet decided, in the form in which it presents itself to study, it differs in many respects from cellular tissue. It is not elastic or yielding to the application of sudden force as the latter; the fibres will break or tear up at their bony attachment, but cannot be stretched or *strained* in the proper sense of the word. But when the force is gradually applied, as by the accumulation of a fluid in a joint, they yield to receive it, by a sort of interstitial expansion or growth, and retract in the same gradual manner, when the distending power is removed. Fibrous tissue contains but little adipose matter, and is affected only to a slight extent in anasarca.

—The labours of the microscopists have recently confirmed the opinion of Chaussier and Bichat.

—They have shown fibrous tissue to consist of fine transparent undulating cylindrical filaments, from $\frac{1}{30000}$ to $\frac{1}{10000}$ of an

inch in diameter. They are generally collected in fasciculi, from $\frac{1}{3750}$ to $\frac{1}{7500}$ of an inch wide, the filaments of which are held together, by a firm structureless amorphous substance, which has received the name of cytoblastema. Under the microscope, the elementary structure of the cellular, fibrous and fibro-cellular tissues, appear to be the same. Their anatomical differences depending on the mode in which their elementary fibres are put together. In fibrous tissue the undulating primitive filaments are arranged side by side into fasciculi, which differ from those of cellular tissue in being much larger, more dense and more opaque and in being straight instead of flexuous. Their whiteness and strength, depend upon the compact parallel disposition of the compound filaments; and their slight amount of elasticity is owing to the absence of sinuosity in the arrangement of the compound fasciculi. According to the manner in which these fasciculi or fibres are arranged and combined, we have either the membranous or fascicular form of fibrous tissue as has heen above explained. Cellular membrane in a more or less condensed state, is found in general intermixed to a greater or less extent, with the fibrous fasciculi.

The Ligaments of the Joints,

—Are all divided into the *capsular* or bag-like, and into *funicular,* or cords.

—The capsular, or fibrous bags, of greater or less thickness, open at both ends, into which the heads of the bones forming the respective joints are thrust, and round the necks of which it is closely inserted, where they are continuous with the periosteum of the bones. In very many of the joints the capsules are imperfect in some part of their periphery, and in others are represented only by a few scattered fibres. The hip and shoulder joint furnish the best specimen of a perfect capsule.

—The funicular ligaments are cords, flat, round, or oval, intended to give a side support to the joints, and constitute the lateral ligaments. These are placed, some within, some

without, and some in the very thickness of the capsular ligament.—

They consist of fibres which are flexible but extremely strong, and in general have but little elasticity; their surfaces are smooth and polished; their colour is whitish and silver-like.

The vessels which enter into their composition do not commonly carry red blood; and although it seems certain that they must have nerves, many very expert anatomists have declared that no nerves could be traced into them.
—A branch of the fourth cranial nerve, has however been found distributed in the dura mater. Blood vessels abound in the periosteum, but they merely divide in that membrane, so as to enter the bone at a great number of points, as has been before observed.—

In a healthy state, they are entirely void of sensibility, and can be cut and punctured, or corroded with caustic applications, without pain. When inflamed they are extremely painful.

The ligaments which connect the different bones to each other, have a very strong resemblance to these tendinous parts, not only in their structure but in their qualities also. Many of them appear rather more firm in their texture and more vascular. Their vessels are also larger: their colour sometimes inclines to a dull white, and when examined chemically, they appear to differ, in some respects, from tendons.

They agree, however, with the tendinous parts as to their insensibility in a sound state, and the extreme pain which occurs when they are inflamed. No nerves have been traced into their structure.

Notwithstanding the ordinary insensibility of these parts, it was asserted by M. Bichat that several animals who seem to suffer no pain from cutting, puncturing, or corroding the ligaments of their joints, appeared to be in great agony when these parts were violently stretched or twisted; and he declared this to be the case when all the nerves which passed over the ligaments, and could have been affected by the

process, were cut away. He explained by this the pain which sometimes occurs instantaneously in sprains, in the reduction of luxations, and in other analogous processes.

The ultimate structure of these parts is, perhaps, not perfectly understood.

An anatomist of the highest authority, Haller, appears to have considered them as formed of membrane, while a late writer, who has paid great attention to the subject, and is also of high authority, M. Bichat, has satisfied himself that their structure is essentially fibrous.

If a tendon, or portion of tendinous membrane, be spread out, or forcibly extended, in a direction which is transverse with respect to its fibres, it will seem to be converted into a fine membrane, and the fibres will disappear to the naked eye. The same circumstances will occur when a ligament is treated in a similar way; but much more force is required.

Thus constructed, these parts are perfectly passive portions of the animal fabric, and have no more power of motion than the bones with which many of them are connected.

But notwithstanding their ordinary insensibility, they often induce a general violent affection of the system when they are diseased. A high degree of fever, as well as severe pain, attends their acute inflammations; and hectical symptoms, in their greatest extent, are often induced by their suppurations.

There is another circumstance in their history which is very difficult to reconcile with their ordinary insensibility. They are the most common seats of gouty painful affections.

In these cases, pain does not seem to be the simple effect of inflammation: it often occurs as the first symptom of the disease; it frequently exists with great violence for a short time and goes off without inflammation, and it is frequently vicarious with affections of the most sensible and irritable parts.

Parts of a tendinous and ligamentous structure do not appear retentive of life, but lose their animation very readily, in consequence of the inflammation and other circumstances which attend wounds.

When thus deprived of life, they retain their usual appear-

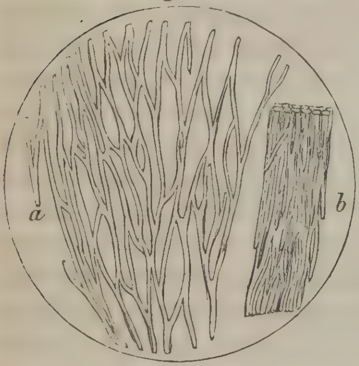
ance and their texture a long time. The dead parts separate from the living in large portions, in a way which has a considerable analogy with the exfoliation of bones.

The tendons and their expansions, and the various fasciæ, have the same chemical composition. If boiled a long time, they dissolve completely, and form the substance called by chemists *gelatine*, or pure glue.

The ligaments differ from them in some respects. When boiled they yield a portion of gelatine, and do not dissolve entirely; but are said to retain their form and even their strength, after a very long boiling. The composition of the part so insoluble in water, has not yet been ascertained.

Of the Yellow Elastic Ligamentous Tissue.

Fig. 48.*

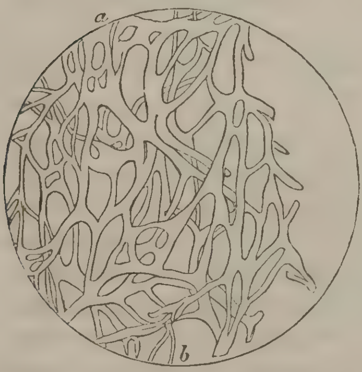


—This is a modification of the common ligamentous tissue, which though not usually treated apart, differs from it in many essential particulars. It contains, according to the younger Girard, some fibrine in its composition; it is eminently elastic, and is placed to give resistance and support to parts, where in other animals, we meet with muscular fibres, for which it is in some sort a substitute. In some situations it is of a deep yellow colour, and rarely presents the silvery aspect of the common tissue. It forms the middle coat of the arteries, the ligaments between the bridges of the vertebræ, the ligamentum nuchæ in quadrupeds with heavy pendant heads, the elastic involucrum of the corpus cavernosum and spongiosum penis in the male, of the clitoris in the female,

* Reticulate elastic tissue from the ligamentum nuchæ of the horse magnified to 200 diameters (from Gerber). *a.* Loosened elastic tissue with the meshes opened. *b.* Elastic tissue in its natural condition, the meshes close; the fibres being disposed in lines and layers, parallel to one another.

and the elastic covering of the spleen; it is found in the ramifications of the bronchia, in various parts of the eye ball, and in the ligaments of the larynx and os hyoides including the vocal chords; we might also add, the elastic membrane of the nose and ear, which are more allied to it, than to cartilage, though they are called membraniform cartilage. This yellow elastic tissue (*tissue jaune*) unlike other ligamentous tissue, yields no gelatine on boiling. It resists decomposition for a very long time, either by maceration, putrefaction, or digestion; it becomes brown and transparent on drying, but not brittle like cartilage.

Fig. 49.*



When examined with the microscope, it is found to bear in the arrangement of its fibres a strong resemblance to a net work of capillary vessels. Its fibres are rigid, prismatic in form and about the $\frac{1}{500}$ part of a line in diameter, highly elastic and interlaced with each other at all angles; its embryonic cells are elongated and mixed with the fibres. If injured it is very imperfectly reproduced; a dense fibrous tissue being substituted in its place. It is very sparingly supplied with blood-vessels.

Of the Fibro-cartilaginous or Ligamento-cartilaginous Tissue. —There is another variety of the desmoid tissue, which holds a middle station between ligament and cartilage, partakes partly of the nature of both, and has been treated of by Bichat as a distinct tissue under this compound name. Vesalius and

* Elastic tissue from the middle fibrous coat of the aorta of the ox magnified 300 diameters. The intertangled fibres, and elongated cells are well shown (from Gerber). These fibres, according to Henle, are contractile, and resemble somewhat the muscular fibres of the stomach.

Morgagni, called them cartilaginous ligaments; Haase, mixed ligaments. Like ligaments, they present a well marked fibrous appearance, and are strong and resisting. Like cartilages, they are white, very dense and elastic. Beclard divides them into the *temporary* and *permanent.**

—The temporary, are those which pass regularly and at determined periods to the state of ossification, and are developed in the midst of the ligaments and tendons, as the patella and sesamoid bones.

—The permanent are of several kinds. 1. Those which are free at both these surfaces, and are lined by the synovial membrane. These constitute the interarticular or meniscous cartilages, (menisci,) and are attached at their outer surface to the inner face of the capsular ligament. They are found in the knee, maxillary, clavicular, and lower ulnar articulations. 2. Those which are adherent by one of their surfaces; these are found whenever the fibrous tissue is subjected to habitual friction by the tendons, as in the different grooves, through which they play, or upon the sides of the ligaments or cartilages, against which they rub; the periosteum, or whatever fibrous membrane it may be, first becomes thickened and then converted into a semicartilage. It also exists in the fibrous rings, placed at the margin of the glenoid and cotyloid cavities for the purpose of deepening their sockets. 3. Those adherent by both surfaces. These are found between the bodies of the vertebræ and the pubic bones.

—The accidental production of this tissue is by no means uncommon; it is found occasionally in the cavities of fractures forming false joints, in the tubercular cavities of the lungs, in the uterus, ovaries, etc.

* Bichat considered the elastic cartilaginous membranes of the nose, ear, and trachea, as belonging to this division of the tissues, but they certainly have a closer affinity to the yellow elastic fibrous tissue.—P.

CHAPTER IV.

A GENERAL ACCOUNT OF ARTICULATIONS, AND OF BURSÆ MUCOSÆ.

Of Articulations.

Those surfaces of bones which form the movable articulations are covered with cartilaginous matter which has been already described.*

—In many of the immobile articulations, as the sacro-iliac symphysis for instance, a thin lamen of cartilaginous matter, with all the other appurtenances of joints, are likewise met with. The connexion between the articular cartilage and the bones is strong, but its nature is not well known. None of the vessels of the bone pass into the cartilage, but terminate in its immediate neighbourhood. Gerdy, (page 29) considers it a secretion from these vessels, and that its formation is like that of the cuticle, from the vessels of the skin. This, however, is but a mere opinion, unsustained by proof. It presents the appearance of a couch of white wax spread over the end of the bones, though it is composed of vertical fibres like the frill of velvet, so crowded together as to leave no sensible interval between them, and presenting a free extremity to the cavity of the joint. The cartilages terminate insensibly at their circumference on the surface of the bone. On the heads of the bones they are thicker at the central part, than at their circumference; in the corresponding socket, the cartilaginous coating is thickest at the margin, and sometimes spreads out into a sort of cartilaginous rim.—

—*On the formation of the epiphysis of the long bones, and its covering cartilage.*—In the fœtus and young subject, there is no distinction between the cartilage that is to become the bone of the epiphysis and that which is to remain as articular carti-

* See page 36.

lage. In my preparations alluded to, page 236, a careful dissection shows branches running from the zone of vessels across the head of the bone isolating the articular cartilage from the epiphysal. These branches have beds of bone formed round them, communicate freely with the vessels of the epiphysis, but appear to send no branches towards the free surface of the articular cartilage. The portion of the articular cartilage immediately overlaying them, is however more tough and periosteal in its character, than that on the free surface of the cartilage, and has been, though not with exact propriety, described by Mr. Liston, as cellular tissue connecting the cartilage and epiphysis. It is well known that in young subjects, the articular cartilage is thick, and the compact layer of the epiphysis below it thin and fragile; while in old persons the compact layer of the epiphysis is thick and strong, and the cartilage covering it thin, rigid, and so firmly united to the bone below, as to be with difficulty removed from it by the ordinary process of cleaning. It would seem from this, that while the cartilage gets its nutritive fluids by imbibition from the epiphysal vessels and the marginal zone, some change is effected by their passage into its structure during the progress of life, by which the inner portions of the articular cartilage is converted into bone. Though in the healthy state no vessels can be injected in cartilage, in some diseases of the joints blood-vessels and granulations may shoot up from the bone below into the place of the cartilage.—It has been most probably in cases of this description, that the appearance of vascularity in the cartilages has been observed; that of Mr. Liston, detailed in a late number of the medico-chirurgical transactions was from a diseased joint.—

The bones are retained in their relative situations by ligaments, such as have been lately mentioned, which are exterior to the cavities of the articulations, and placed in such situations that they permit the motions the joints are calculated to perform, while they keep the respective bones in their proper places.

Of the Synovial Capsules.

—The synovial capsules are formed of an extremely thin transparent, double reflected tissue, the vessels of which circulate in the healthy state only the serous portions of the blood, and which, though erected into a distinct tissue or system by Bichat, under the name of synovial, is now generally considered as forming only a part of the general serous tissue, which it closely resembles in structure, and with which it intimately sympathises in disease. They are of three kinds: 1st. Those which line the inner surface of the ligaments of the joints, and are reflected over the surfaces of the articular cartilages. These are called the *articular synovial cartilages.* 2d. Those which are placed between the tendons of the muscles, and the bones and cartilages against which the tendons rub. These are called *bursæ mucosæ.* 3d. Those which are placed between the skin and the bones, tendons, or other hard parts, over which it performs frequent and extensive movements. These are called the *subcutaneous synovial capsules.*—

Of the Articular Synovial Capsules.

They are invested in a particular manner by a thin delicate membrane, which in some joints, as those of the hip and shoulder, seems to be the internal lamina of a stronger ligament called the capsular; and, in other joints, the knee, for example, appears to be independent of any other structure. In each case, this synovial membrane, as it has lately been called, forms a complete sac or bag which covers the articular surface of one bone, and is reflected from it to the corresponding surface of the other; adhering firmly to each of the articulating surfaces, and extending loosely from the margin of one surface to that of the other.

In the distribution it supplies the place of perichondrium to the cartilages, and of periosteum to those surfaces of bone with which it is connected.

It seems greatly to resemble the membranes which line the abdomen and thorax, and invests the parts contained in these

cavities; and like them it may be termed a reflected membrane.

It is thin and very flexible, but dense and strong.

It secretes, or effuses from its surface, a liquor, called synovia; which is particularly calculated to lubricate parts that move upon each other.

The fluid is nearly transparent: it has the consistence of a thin syrup, and is very tenacious or ropy. It mixes with cold water, and, when heated, becomes milky, and deposits some pellicles without losing its viscidity. It appears to be composed of eighty parts in one hundred of water; above eleven parts of fibrous matter; and between four and five parts of albumen. It also contains a small portion of soda, of muriate of soda, and of phosphate of lime.

There are in many of the joints masses of fat which appear to project into the cavity, but are exterior to the synovial membrane, and covered by it; as the viscera in the abdomen are covered by the peritoneum.

They are generally situated so as to be pressed gently, but not bruised, by the motions of the bones.

In some joints, they appear like portions of the common adipose membrane; in others, they appear more vascular, and have a number of blood-vessels spread upon them. Small processes often project from their side like fringe.

These masses have been considered as synovial glands; but they do not appear like glands; and it is probable that the synovia is secreted by the whole internal surface of the membrane.*

The synovial membrane, like the other parts of joints, is insensible in a sound state, but extremely painful when inflamed. The synovia, which is secreted, during the inflamation of this membrane, has a purulent appearance.

—For the sake of facility in description it is common among anatomists, without admitting or denying the fact, to consider

* Clopton Havers, ignorant that the synovia was derived by a sort of perspiration from the inner surface of this membrane, supposed it to be secreted by these masses of adipose matter, which are still known, in perpetuation of his mistake, as *Havers' glands*.—P.

the synovial membrane as passing over the face of the articular cartilages; it has however long been a question among anatomists and surgeons, whether such be really the case. It can only be traced by the knife as far as the circumference of the cartilages, nor can vessels by any means in the healthy state be injected in it beyond this point. If it exist upon the cartilages, it is certainly so modified as not to be recognisable. It is asserted by Mr. Toynbee* that it covers the cartilage as a vascular membrane only in the early periods of fœtal life—and that towards the period of birth the sub-synovial vessels, gradually recede from the surface of the articular cartilage and form a zone around its margin; a change somewhat like that which takes place in the membrana pupillaris. I have several minutely injected preparations of the joints taken from young subjects, which show this zone of vessels, arranged in loops somewhat like the mesenteric arches, around the beveled circumference of the cartilage, which are strongly confirmatory of this opinion. But whether the synovial membrane recedes with these vessels, or becomes so altered in character as to form a smooth insensitive covering to the cartilage has not yet been determined. An amputation at the knee joint which I performed during the past winter at the Philadelphia Hospital, before the class of the Jefferson Medical College, gave me an opportunity of observing the changes daily, that are produced by morbid causes in the cartilages of the joints. From the diseased condition of the integuments of the leg, there was a scantiness of flap for covering the stump, which left the condyles partly exposed to view.

—From round the *margin* of the cartilage and the place of attachment of the crucial ligaments, in front of which the synovial membrane passes, there was in the course of a fortnight inflammation, secretion and a vigorous growth of granulations. On the surface of the cartilage of the condyles there appeared to be up to this time the slightest change; it preserved its polished shining aspect and was totally insensible to the contact of an instrument. In the course of a few days more it

* Memoir on the non vascular tissues, Phil. Trans. 1841.

lost its polish, became soft and pulpy, like a joint exposed to maceration in a dissecting room, and melted off, flake after flake, till the compact layer of bone covering the cells of the epiphysis below was exposed to view. This layer was at first dark coloured, but soon became red and sensitive to the touch. Small firm whitish conical elevations, appeared over its surface; these grew by degrees into strong and healthy granulations, to which the inner face of the flaps, at the end of six weeks were firmly connected, leaving the patient a solid and serviceable stump, upon which she is able to bear her weight with the ordinary wooden support. The patient suffered none of the constitutional irritation common to synovial inflammation and it would be difficult to believe from the progress of this case, and analogous ones reported by other surgeons, either that the synovial membranes are spread over the cartilages of joints, or that the cartilages themselves are vascular.

Of Bursæ Mucosæ.

There are certain membranous cavities called bursæ mucosæ which are found between tendons and bones, near the joints, and in other places also, which have so strong a resemblance to the synovial membrane, and are so intimately connected with some of the articulations, that they ought now to be mentioned.

They are formed of a thin dense membrane, and are attached to the surrounding parts by cellular substance; they contain a fluid like the synovia; and sometimes there are masses of fat, which, although exterior to them, appear to project into their cavities.

There is, commonly, a thin cartilage, or tough membrane, between them and the bone on which they are placed.

They often communicate with the cavities of joints, without inducing any change in the state of the part.

As they are always situated between parts that move upon each other, there is the greatest reason to believe that they are intended to lessen friction.*

* For further information respecting this subject, as well as joints in general, the reader is referred to a Description of the Bursæ Mucosæ of the Human Body, by Alexander Monro; to whom the world is so much indebted for the elucidation of many important points in anatomy and physiology.

These bursæ mucosæ are very numerous, as will appear from a subsequent account of them.

Several of them are very interesting on account of their connexion with very important joints.

—These bursæ form *synovial sheaths to the tendons*, where they run through grooves in the bones, or under their vaginal ligaments, or where they glide over each other, as in the palms of the hands and the soles of the feet: but they are especially met with, wherever a tendon changes its direction, and converts a bone, a cartilage, or ligament into a pulley; of which instances will be detailed hereafter. When a bursæ, or tendinous sheath, invests a tendon about to subdivide, as the flexor tendons of the fingers at the wrist, the sheath also subdivides so as to send a process along each parting tendon; a knowledge of which fact is of importance to the surgeon, as this membrane when injured, is much disposed to continuous inflammation.

—The number of these bursæ vary in different individuals. Ollivier reckons them at one hundred pairs.

Subcutaneous Synovial Capsules.

—These have been long observed about the wrist, ankle and knee, where they sometimes attain the size of walnuts, and are known to surgeons under the names of *ganglions* and *hygroma.* They were studied and described for the first time, however, by Beclard. They exist wherever the skin is strongly and frequently moved over a resisting part: as between the skin and the patella; between the olecranon and skin; over the trochanter; acromion; thyroid cartilage; at the metacarpal and metatarsal articulations, &c. &c. They are developed accidentally in different parts, when from any cause, as in curvature of the spine, the friction of the tendons is increased. When inflated, the cavities appear oblong and cellulated, contain some synovial fluid, and look like dilated cells of the cellular tissue, of which they are in all probability formed; many of them, however, are visible in the fœtus during the latter period of utero-gestation.—

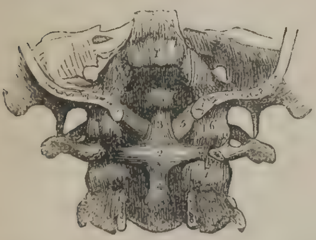
CHAPTER V.

OF PARTICULAR ARTICULATIONS.

The connexion of the Head with the Vertebræ.

The condyles of the occipital bone, and the corresponding cavities of the atlas, are covered with cartilage. The condyle and cavity on each side are invested with a synovial ligament, as described in the general account of articulations.

Fig. 50.*



An anterior ligament, *(ligamentum occipito-atloidal anterior,)* descends from the front part of the great occipital foramen, and is inserted into all the front part of the atlas, between its articulating processes. That portion of this ligament which is in the middle, and inserted into the tubercle of the atlas, appears stronger, and is distinct from the rest of it.

A posterior ligament, *(ligamentum occipito-atloidal posterior,)* passes from the posterior margin of the occipital foramen to the upper edge of the posterior arch of the atlas.

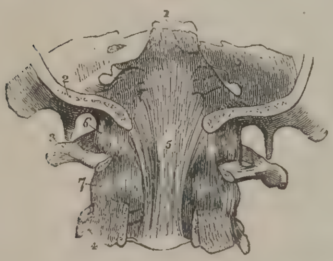
From each side of the upper end of the tooth-like process of the vertebra dentata, a ligament *(oblique, or moderator,)* passes upwards and outwards, to be inserted into the internal side of the basis of each condyle of the occipital bone. There

* A posterior view of the ligaments connecting the atlas, the axis, and the occipital bone. The posterior part of the occipital bone has been sawn away, and the arches of the atlas and axis removed. 1. The superior part of the occipito-axoid ligament, which has been cut away in order to show the ligaments beneath. 2. The transverse ligaments of the atlas. 3, 4. The ascending and descending slips of the transverse ligament, which have obtained for it the title of cruciform ligament. 5. One of the odontoid or moderator ligaments. 6. One of the occipito-atloid capsular ligaments. 7. One of the atlo-axoid capsular ligaments.

is a small ligament, called the middle straight ligament *(ligamentum medium rectum,)* which passes from the tip of the dentated process, to be inserted on the inner face of the occipital foramen between the insertion of the moderator ligaments.

From the anterior margin of the great occipital foramen, a ligament passes down on the inside of the vertebral cavity, over the tooth-like process, which is inserted in the body of the vertebra dentata, and the ligaments connected with it. This ligament is composed of a number of fibrous bands called by Caldani, *lacerti ligamentosi.* This must be dissected away before the moderator and transverse ligaments can be brought into view. See fig. 51. It is now more appropriately named the *occipito-axoid ligament.*

Fig. 51.*



There is also a ligament which runs across from one side of the atlas to the other, to confine the tooth-like process in its anterior cavity, see fig. 50, page 239, *(transverse ligament, ligamentum transversale atlantis.)* This ligament adheres above to the occipital bone, and below to the body of the vertebra dentata. The anterior surface of the tooth-like process plays on the anterior arch of the atlas; the posterior surface plays on this ligament. A synovial capsule is placed on each surface of the tooth-like process.

—From the middle of this transverse ligament a band of fibres extend downward to the vertebræ below, giving a cruciform arrangement to the ligament. See fig. 51.

* The upper part of the vertebral canal, opened from behind in order to show the occipito-axoid ligament. 1. The basilar portion of the sphenoid bone. 2. Section of the occipital bone. 3. The atlas, its posterior arch removed. 4. The axis, the posterior arch also removed. 5. The occipito-axoid ligament, rendered prominent at its middle by the projection of the odontoid process. 6. Lateral and capsular ligament of the occipito-atloid articulation. 7. Capsular ligament between the articulating processes of the atlas and axis.

The articulating surfaces of the oblique process of the atlas and vertebra dentata on each side, are invested by a synovial membrane. There are, also, additional ligaments placed before and behind these processes, that have an effect on their motions.

The uses of these different ligaments are very obvious when they are dissected. The transverse ligament of the atlas, with the synovial membranes form an articulation for the tooth-like process, which is of a peculiar kind. The ligaments that pass from this process, to the bones of the condyles of the occipital bone, must have an effect in restraining the rotation of the head and atlas on this process, and therefore have been called moderator ligaments.

The Articulations of the Vertebræ with each other.

To acquire a perfect idea of the construction of the Spine it is necessary to examine, at least, two preparations of it: in one of which the bodies of the vertebræ should be sawed off from the processes, so that the spinal canal may be laid open.

The bodies of all the vertebræ, except the atlas, are connected to each other by the *intervertebral* fibro-cartilaginous matter described in page 138, which unites them very firmly, at the same time that it allows of some motion, in consequence of its elasticity and compressibility. This connexion is strengthened by two ligaments, which extend the whole length of the spine, from the second cervical vertebra to the sacrum.

The first of these, denominated the *anterior vertebral ligament*, covers a considerable part of the anterior surface of the bodies of the vertebræ; it is thickest in the middle, and varies in its breadth in different parts of the vertebral column; it adheres very firmly to the intervertebral substance, and not so firmly to the bodies of the vertebræ. It has the shining silver-like appearance of tendon, and seems to consist entirely of longitudinal fibres. There are many fibres which appear to be connected with it, that do not extend the whole length of the spine.

On the posterior surface of the bodies of the vertebræ, in the cavity which contains the spinal marrow, is the *posterior or internal vertebral ligament*, which, like the anterior, extends from the upper part of the spine to the sacrum.

In its progress downwards it is broader where it is in contact

with the intervertebral matter, and narrower about the middle of each of the bodies of the vertebræ. It appears to consist of longitudinal tendinous fibres, which are similar to those of the anterior ligament. The fibres of which these ligaments are composed, are more closely connected by origin and insertion with the intervertebral matter, than with the bodies of the vertebræ. Some of the fibres are inserted into the next vertebræ or intervertebral substance below their place of origin, others into the second or third, and some into the fourth or fifth.

The oblique processes of the vertebræ are covered with cartilage, and are invested with a synovial membrane, like the other movable articulations. In the neck and back these membranes are thin and delicate; but in the loins they are blended with ligamentous fibres which give them additional strength.

Some of the most curious and interesting ligaments of the spine, or indeed of the body, are those which are attached to the bony plates or arches that extend from the oblique to the spinous processes of each vertebræ. These plates form a great portion of the posterior part of the vertebral canal and the vacant spaces between them are filled up by these ligaments, which extend from the plates of each upper vertebra of those of the next vertebra below.

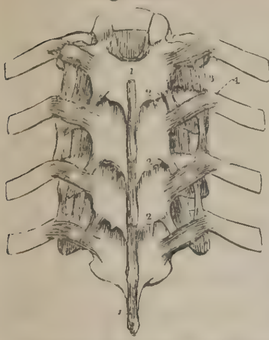
They are situated between the spinal process and the oblique processes on each side.

They are, therefore, two distinct ligaments between the two vertebræ, one on each side of the spinal process; and as they extend only from the plates or arches of one vertebra to those of the other, they must necessarily be very short. They are much more conspicuous on the internal surface of the vertebral cavity than they are externally. They are thick and substantial, and very elastic; their colour resembles that of a yellowish adeps; and from that circumstance they are called the *yellow* or *elastic ligaments*. They complete the cavity for the spinal marrow. There are twenty-three pairs in all.

As the plates or arches to which they are connected must

recede from each other, when the spine is bent forwards, it seems that they should be elastic.

Fig. 52.*



There are also ligaments between the spinous processes, which extend from the under surface of one spinous process to the upper surface of the spinous process below it. These are composed of tendinous shining fibres, and are sufficiently loose to permit the anterior flexure of the vertebral column. From their situation they are denominated *interspinal ligaments.*

There is also a thin and narrow ligamentous band, which extends from the spinous process of the seventh cervical vertebra to the spinous processes of the os sacrum, and adheres to the ends of the intermediate spinous processes. It is exterior to the tendinous origins of the trapezii and latissimi dorsi muscles. The upper portion is slightly connected to the trapezius, the lower part adheres more firmly to the latissimus dorsi.

The *ligamentum nuchæ, ligament of Diemerbræk,* as it has been denominated, is a narrow but firm strip, which extends from the spinous process of the last cervical vertebra, to the occipital bone, at or near its protuberance. It is very strongly developed in all the larger quadrupeds, with pendant heads. That portion of the trapezius muscle which is between the occipital bone and the seventh cervical vertebra, originates from it, or is intimately connected with it; and a portion of the splenius muscle is also connected with it.

From the internal surface of this ligament, a thin tendinous membrane arises, whose fibres run obliquely upwards and

* A posterior view of a part of the thoracic portion of the vertebral column, showing the ligaments connecting the vertebræ with each other and the ribs with the vertebræ. 1. The supra-spinous ligament. 2, 2. The ligamenta subflava, or yellow elastic ligaments, connecting the laminæ. 3. The anterior costo-transverse ligament. 4. The posterior costo-transverse ligaments.

forwards, and are inserted into the spinous processes of each of the cervical vertebræ above the seventh, and also into the atlas and the os occipitis. Attached to the ligamentum nuchæ and to the spine, this membrane seems like a partition between the muscles which lie on each side of the back of the neck.

After inspecting the different ligaments of the spine, it will be obvious that the *yellow ligaments* are among the most important of them; in consequence of their *position, their strength, and their elasticity.*

Articulation of the Lower Jaw, (Temporo-maxillary.)

The glenoid cavity of the temporal bone with the tubercle before it, and the condyle of the lower jaw, are covered with cartilages. A cartilage is placed between them called *inter-articular*, which being flexible, is accommodated to the convexity of the condyle and hollowness of the glenoid cavity, and also to the figure of the aforesaid tubercle to which it is extended. A synovial capsule, or bag, invests the glenoid cavity and the tubercle, and covers the upper surface of the cartilage. A second capsule of the same kind is attached to the condyle of the lower jaw, and the lower surface of the cartilage. A few ligamentous fibres extend from the circumference of the cavity and tubercle of the temporal bone, over both synovial capsules and the cartilage between them, to the lower jaw below the condyle, and appear to be attached to the cartilage.

These fibres are collected in such numbers, on the external and internal sides of the articulation, that they have been called the *external* and *internal lateral ligaments.*

Another ligament called *stylo-maxillary*, is mentioned which arises from the styloid process of the temporal bone, and is inserted into the lower jaw near its angle; but this seems rather appropriated to the stylo-glossus muscle than to this articulation.

In consequence of this structure, the condyle of the lower jaw moves out of the glenoid cavity upon the tubercle, when the mouth is opened widely.

Articulation of the Clavicle and Sternum, called Sterno-clavicular.

The connexion of the clavicle and sternum resembles strongly that of the lower jaw and temporal bone. A movable cartilage is placed between the articulating surfaces, with a distinct synovial capsule on each side of it, applied in the usual manner to the corresponding surface of the clavicle and of the sternum. Exterior to these capsules and the intervening cartilage, are many ligamentous fibres, which are most numerous on the anterior and posterior surfaces, but diverge from each other as they proceed from the clavicle to the sternum, and are, therefore, called *Radiated Ligaments.*

There is a strong ligament called the *Interclavicular*, which passes across the sternum internally, from one clavicle to the other.

And another ligament, which arises from the inferior rough surface of the clavicle, near the sternum, which is inserted into the cartilage of the first rib.

This is called the *Rhomboid, or Costo-clavicular* ligament.

Articulations of the Clavicle and Scapula, (Scapulo-clavicular.)

Fig. 53.*

These are two in number; one which connects the acromion and external end of the clavicle called *acromio-clavicular*, and one which connects the lower surface of the outer part of the clavicle with the coracoid process of the scapula, called *coraco-clavicular.*

Acromio-clavicular. The small surfaces of the clavicle and scapula, which are in contact with each other, are furnished

* The ligaments of the sterno-clavicular and costo-sternal articulations. 1. The anterior sterno-clavicular ligament. 2. The inter-clavicular ligament. 3. The costo-clavicular or rhomboid ligament, seen on both sides. 4. The inter-articular fibro-cartilage, brought into view by the removal of the anterior and posterior ligaments. 5. The anterior costo-sternal ligaments of the first and second ribs.

with the apparatus of a movable articulation. They are covered with cartilage, and are invested with a small synovial capsule. The upper and lower surfaces of the extremities of the clavicle and acromion are covered by a ligamentous membrane, which is called, from its situation, the *superior* and *inferior ligament* of this articulation.

Coraco-clavicular, consisting of two portions, conoid and trapezoid. But these bones are more firmly connected by the ligament which passes to the coracoid process of the scapula from the under side of the clavicle, and is very strong. Some of the fibres which compose this ligament are so arranged that they have the appearance of an inverted cone: the remaining fibres appear like another ligament, and therefore they have been called the *trapezoid* and *conoid* ligaments.

—The base of the conoid ligament is upwards, and its apex or origin is at the root of the coracoid process. It is the stronger of the two. The trapezoid is at the outer side of the conoid. It is broad and thin, with its fibres separated by interstices. It rises from the root of the coracoid process, and is inserted on an oblique ridge, leading from the tubercle of the clavicle to its acromial end.—

By their situation and strength they are enabled to retain the bones in their proper relative positions, at the same time that they permit a peculiar rotary motion.

—There is a bifid ligament called *ligamentum bicorne,* arising from the root of the coracoid process, at the inner side of the conoid, which runs inwards in front of the subclavius muscle, to which it serves as a fascia, and bifurcates; one horn is attached to the under surface of the clavicle near the rhomboid ligament, and the other to the end of the first rib, under the tendon of the subclavius muscle.—

Articulation of the Os Humeri and Scapula, (Scapulo-humeral.)

The spherical portion of the upper extremity of the os humeri is the part of that bone which is principally concerned in the articulation, and is covered with cartilage; as is also the glenoid cavity of the scapula.

Fig. 54.*

The glenoid cavity of the scapula, which is so small in the dried bone, when compared with the head of the os humeri, is enlarged by the long tendon of the biceps muscle, which is attached to the upper edge of its margin, and then divides and passes down on each side of the cavity, increasing the breadth of it considerably, thus forming what is called the *glenoid ligament*, deepening the socket, and giving greater latitude of motion to the arm, from its elasticity, than if the socket had all been formed of bone. It appears to be blended with the cartilage that lines the cavity, and also with the capsular ligament which is exterior to it.

The articulating surface, thus composed, is perfectly regular and uniform.

The synovial ligament, in this articulation, is so blended with an external stronger ligament, that it cannot be separated in the recent subject; but, notwithstanding, it is applied to the articulating surfaces in the same way that it is applied to the other joints forming a capsule. The stronger exterior lamina is, of course, only applied to that part of the synovial capsule which proceeds from the margin of one cartilaginous articulating surface to the other: it appears to be most intimately connected with the periosteum, and is rendered more firm and thick in particular parts, by the addition of fibres from the tendons of the supra and infra-spinatus, and subscapularis muscles with which it is blended.

It arises from the scapula at a small distance from the mar-

* The ligaments of the scapula and shoulder joint. 1. The superior acromio-clavicular ligament. 2. The coraco-clavicular ligament; this aspect of the ligament is named trapezoid. 3. The coraco-acromial ligament. 4. Coracoid or transverse ligament as it is sometimes called. 5. Capsular ligament. 6. Coraco-humeral ligament. 7. The long tendons of the biceps issuing from the capsular ligament, and entering the bicipital groove.

gin or edge of the glenoid cavity, as formed by the tendon of the biceps, and is inserted into the os humeri at a small distance from the edge of the cartilaginous articulating surface; and, if dissected away from the bones, would appear like a cylindrical bag with both extremities open.—The capsular ligament is thickened in front by a band of fibres, arising from the outer part of the back surface of the coracoid process, which proceeds beneath the triangular ligament to the upper part of the os humeri; it is closely blended with, and forms a part of the capsular ligament, and is denominated the *coraco-humeral ligament,* or *ligamentum adscititium.*—

The long tendon of the biceps muscle, in the groove at the head of the os humeri, appears to penetrate this ligament; but it is not within the cavity of the synovial membrane; for this membrane sends down a process like the finger of a glove, which lines the groove, and is reflected from its surface upon the surface of the tendon, and covers it during its whole extent, being reflected from the tendon, at its upper termination, to the adjoining surface; so that the tendon is in fact outside of the synovial capsule, which, therefore, confines the synovia completely.

This capsular ligament, which is one of the strongest, would not avail much in keeping the bones in their proper situations, if the muscles and their tendons were not disposed in such a manner, that when the muscles act, their power is excited to the same effect. In some cases of paralytic affection, where the muscles exert no influence, the weight of the arm, when it is allowed to hang without support, draws the head of the os humeri, below the glenoid cavity, notwithstanding the capsular ligament. At the same time it ought to be observed, that this ligament must be lacerated in every case of complete luxation of the os humeri; as it cannot possibly distend sufficiently to permit the separation of the bones to the extent which then takes place.

The Articulation of the Elbow.

Those surfaces of the os humeri, ulna, and radius, which move upon each other, are covered with cartilage.

Fig. 55.*

The motion of the ulna and radius on the os humeri is that of the simple flexion and extension. The cylindrical head of the radius performs a part of a revolution, nearly on its own axis, without moving from the depression in the side of the ulna, with which it is in contact.

The synovial membrane adheres very firmly to the surface covered with cartilage on each of the bones, and is reflected from the margin of this surface, on one bone, to that of the others. As the principal motion performed is hinge-like, the principal ligaments are on the sides. There is also a circular ligament, which arises from the ulna and invests the narrow part of the radius immediately below its cylindrical head like a loop, to confine the radius in contact with the ulna, and at the same time permit its motion.

This ligament is so blended with the synovial membrane, that it sometimes cannot be separated from it.

The lateral ligaments are denominated from their origin and insertion, *Brachio-radial*, and *Brachio-cubital*, or *External* and *Internal.* The external is a strong, narrow band, attached above to the external condyle of the humerus, and below to the orbicular ligament, and adjoining ridge of the ulna. The internal, is thick and triangular; its apex is attached to the internal condyle of the humerus, and its lower or broad part is inserted into the margin of the greater sigmoid fossa of the ulna extending from the coronoid process to the olecranon.—Posterior to it runs the ulnar nerve. The ligament which invests the neck of the radius is called *Coronary* or *Orbicular.*

* An internal view of the ligaments of the elbow joint. 1. The anterior ligament. 2. The internal lateral ligament. 3. The orbicular ligament. 4. The oblique ligament. 5. The interosseous ligament. 6. The internal condyle of the humerus, which conceals the posterior ligament.

Fig 56.*

—The orbicular ligament is a firm band several lines in breadth, which surrounds the head of the radius, and is attached by each end to the extremities of the lesser sigmoid cavity. It is strongest behind where it receives the external lateral ligament.—On its inner surface it is lined by a process of synovial membrane from the elbow joint.—When this ligament is ruptured, as often occurs in children, the head of the radius readily slips from its place.—

There are also some ligamentous bands, which run upon the front and back parts of the joint to strengthen it, which are called *Anterior* and *Posterior* accessory ligaments.—They are broad thin membranous layers placed on the outer surface of the synovial membrane, and are both attached to the humerus above, and upon the sides to the lateral ligaments: below the posterior is attached to the olecranon; the anterior to the coronoid process of the ulna and to the lateral ligament. Within the synovial membrane, in the upper margins of the depressions for the olecranon and coronoid processes of the ulna, are the adipose substances usually found in joints.

Articulation of the Wrist.

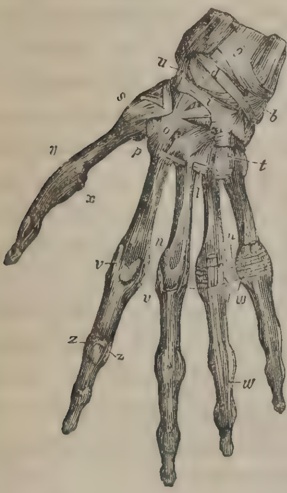
The structure of the wrist is particularly complex, because it consists of three articulations, which are contiguous to each other, viz. That of the ulna and radius; of the radius and first row of carpal bones, *radio-carpal*; and of the first and second row of carpal bones with each other, *middle carpal joint*.

An oblong convex head is formed by the upper surfaces of the scaphoides and lunare, and a portion of the upper surface

* External view of the elbow joint. 1. Humerus. 2. Ulna. 3. Radius. 4. The external lateral ligament inserted below into the orbicular ligament. 6. The posterior extremity of the orbicular or coronary ligament, spreading out at its insertion into the ulna. 7. The anterior ligament, scarcely seen in this view of the articulation. 8. The posterior ligament, thrown into folds by the extension of the joint.

of the cuneiforme bone. This head is covered by one cartilage, which is so uniform that the different bones cannot be distinguished from each other. The lower end of the radius is articulated with this head, but does not cover the whole of it; a portion of this head, therefore, is under the ulna, but not in contact with that bone: for the cartilage which lines the concavity of the radius, is continued beyond the radius, so as to cover the remainder of the head, formed by the carpal bones.

Fig. 57.*



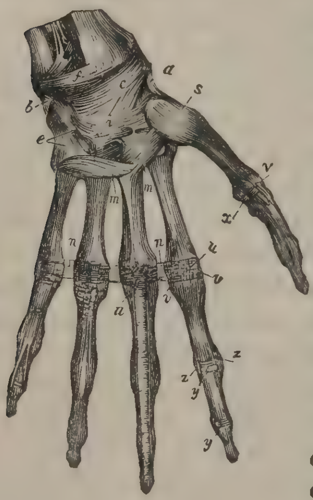
—This cartilage which is extended from that covering the radius, is attached to a depression on the inner surface of the styloid process of the ulna. It is called the *inter-articular* or from its shape the triangular fibro-cartilage. The synovial membrane forming the joint between this cartilage and the end of the ulna is loose and is called the *sacciform membrane*, (see fig. 57,) The lower end of the ulna is in contact with the upper surface of this cartilage, and is articulated laterally with the semilunar cavity of the radius. This semilunar cavity

* A careful dissection being made, the ligaments of the carpus will appear as seen in this and the following figures.—

Dorsal surface. *a.* External lateral ligament. It runs from the styloid process of radius to os scaphoides. *b.* Internal lateral ligament which runs from the styloid process of the ulna and divides into two fasciculi, one of which is attached to the pisiform, the other to the cuneiforme bone. *d.* Posterior or dorsal ligament of the radio-carpal articulation. They are thin and weak and run from the radius to the first row of bones. *g.* Posterior radio ulnar ligament. *i.* A posterior or dorsal thin band of fibres, which connects the two rows of bones together. *l.* Dorsal ligaments, which connect the metacarpal bones together at their base. *n.* Dorsal ligament connecting the anterior ends of these bones. *o.* A middle dorsal ligament stretched from the second metacarpal bone to the trapezoid. *p.* An external ligament running from this bone to the trapezium; another internal one running from this bone to the os magnum, is not here seen. *r.* An oblique ligament, running from the os unciforme to the third metacarpal bone. *s.* Capsular ligament of the metacarpo-carpal articulation of the thumb. *t.* A sort of capsular ligament of the metacarpo-carpal joint of the little finger. *w.* The place of dorsal ligament supplied in a great measure by extensor tendon. *z.* Lateral ligament.

is lined by a cartilaginous process, continued from the upper surface of the aforesaid cartilage; so that the extremity and the side of the ulna play upon the cartilage continued from the radius. This articulation of the ulna and radius is distinct from that of the radius and carpus.

Fig. 58.*



A synovial membrane covers the articulating head formed by the three bones of the carpus, and is reflected from the margin of their cartilaginous surface, to the cartilage at the end of the radius. A plait or fold of this membrane passes from the head of the carpus, at the junction of the scaphoides and lunare, to the opposite part of the cartilage of the radius, and has been called the *Mucous Ligament, (ligamentum mucosum.)*

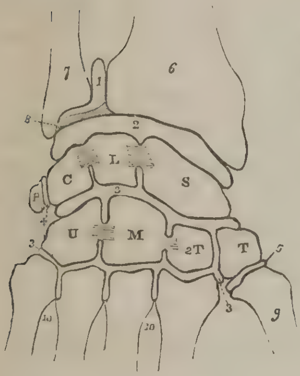
A *strong ligament (internal lateral)* is placed on the internal side of this articulation, which arises from the styloid process of the ulna, and is inserted into the anterior transverse ligament which confines the flexor tendons, and into the pisiforme and cuneiforme bones.

* Anterior or palmar surface. *a.* External lateral ligament. *b.* Internal lateral ligament. *c.* Three anterior or palmar ligaments belonging to the articulation of the first row of bones with the radius, or the radio-carpal articulation. They run from the radius to the bones of the carpus. *e.* Two very strong inferior ligaments which connect the pisiform and cuneiform bones together: besides these, four other ligaments are discovered at this articulation, an external, an internal, and two lateral. So strong is this articulation, that the pisiform bone is rarely if ever dislocated. *f.* Anterior radio-lunar ligament. Articulation of the two bones together. *l.* An anterior or palmar ligament, running from the os magnum, and diverging to the three inner bones of the first row. *m.* Palmar ligaments which connect the metacarpal bones at their base. There is another set of fibres called the interosseous, not seen here, which connect these bones at their base. *n.* Palmar or transverse ligament at the anterior end of these bones. *s.* Capsular ligament of the thumb. *u.* Ligamento-cartilaginous, thickens over the first joint of the fingers. *v.* Lateral ligaments. *y.* Palmar or glenoid ligaments, as they seem to deepen the articular surface for the phalanges.

Another ligament, (external lateral,) on the external side, arises from the styloid process of the radius, and is inserted into the scaphoides, some of its fibres being continued into the aforesaid transverse ligament, and the trapezium.

There are *two* broad irregular *ligamentous membranes:* one of which arises from the anterior margin of the articulating surface of the radius; and the other from the posterior margin. One of them is inserted anteriorly, and the other posteriorly, into the margin of the corresponding surface of the scaphoides, lunare and cuneiforme. They adhere to the synovial membrane; but in some places this membrane appears through apertures which are in them.

Fig. 59.*



The surfaces, by which the first and second rows of carpal bones are articulated with each other, are very irregular. The magnum and part of the unciforme form a prominent oblong head; on each side of which is a much lower surface, formed by the trapezium and trapezoides externally, and the remaining portion of the unciforme internally.† The scaphoides, lunare, and cuneiforme, form a cavity which corresponds with this head, and also with the lower surface

* A diagram showing the disposition of the five synovial membranes of the wrist joint. 1. The sacciform membrane. 2. The second synovial membrane. 3, 3. The third, or large synovial membrane. 4. The synovial membrane between the pisiform bone and the cuneiforme. 5. The synovial membrane of the metacarpal articulation of the thumb. 6. The lower extremity of the radius. 7. The lower extremity of the ulna. 8. The interarticular fibro-cartilage. *S*. The scaphoid bone. *L*. The semilunare. *C*. The cuneiforme; the interosseous ligaments are seen passing between those three bones and separating the articulation of the wrist (2) from the articulation of the carpal bones (3). *P*. The pisiforme. *T*. The trapezium. 2T. The trapezoides. *M*. The os magnum. *U*. The unciforme; interosseous ligaments are seen connecting the os magnum with the trapezoides and unciforme. 9. The base of the metacarpal bone of the thumb. 10, 10. The bases of the other metacarpal bones.

† The palm of the hand is supposed to present forward.

formed by the unciforme; while another surface of the scaphoides is articulated with the trapezium and trapezoides. These corresponding surfaces, formed by the two rows of carpal bones, irregular as they are, compose but one articulation, which is capable of a limited flexion and extension. It has a synovial membrane, with two lateral ligaments, and an anterior and posterior ligament; these last, however, are short, and can be best examined from within, by cutting open the articulation.

The bones of each row move laterally upon each other. Their lateral surfaces, which are in contact, are covered with cartilage; and the synovial sac which exists between the first and second row of bones, sends off processes between these surfaces, which are disposed like the ordinary synovial membranes in other articulations; adhering, as is supposed, to each of the cartilaginous surfaces, while they communicate with the larger cavity between the two rows.

—Interosseous ligaments pass between the three outer bones of the upper row, and the three inner of the lower so as to intercept at these points the distribution of the synovial membranes between the individual bones of each row. By this means there is, as seen in fig. 59, including the sacciform membrane, five synovial membranes in the wrist joint.

Articulation of the Carpal and Metacarpal Bones.

The metacarpal bones are connected to the last row of the carpus by surfaces which are covered with cartilages, and supplied with synovial membranes, as the most movable articulations are; but the ligaments which connect these bones do not permit much motion between them. The ligaments are all dorsal and palmar. The irregularity of the articulating surfaces of the metacarpal bones of the index and middle finger also contribute to restrain their motion; and these bones accordingly move less than the other two metacarpal bones, whose surfaces are better adapted for motion.

Articulation of the Fingers.

The first joint of the fingers has a large synovial membrane, which invests the head of the metacarpal bone and the corresponding cavities of the bones of the first phalanx. On each side is a strong lateral ligament, which arise from the side of the head of the metacarpal bone, and is inserted into the side of the base of the first phalanx.

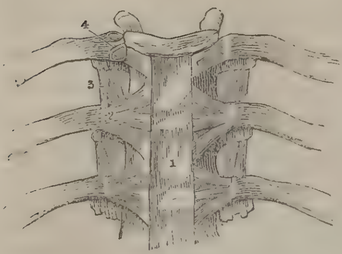
Anteriorly there is also a ligament, which, although thick and strong, is very flexible. It is thickened by cartilaginous matter on its palmar face, which serves as a sort of pully to the tendons, and increases their power by removing them from their line of action. Posteriorly the expansion of the tendons of the extensor muscle, and the tendons of the interossei, have the effect of a ligament.

The different phalanges are articulated with each other in a similar manner. The lateral ligaments are very strong: the tendon of the extensor covers the articulation posteriorly; and anteriorly, under the flexor tendons, there is a soft, but thick ligamentous substance. The metacarpal bone of the thumb differs greatly from the other metacarpal bones in its articulation with the wrist, as respects its motions. The articulating surfaces are calculated for lateral motion as well as flexion and extension; and there are no ligaments which prevent it. Its capsular ligament forms a complete sac. The first joint of the thumb resembles considerably that of the fingers; and the second joint resembles the last of the phalanges.

Articulation of the Ribs.

The ribs are connected to the bodies of the vertebræ and the intervertebral cartilages, by one articulation, and to the transverse processes of the vertebræ by another: these articulations have the ordinary apparatus for motion, with capsular ligaments, which in one case pass from the heads of the ribs to the bodies of the vertebræ, and in the other from the tubercles to the transverse processes. These form what are called the *costo-vertebral, and costo-transverse* articulations.

Fig. 60.*



—The capsular ligament of the *costo-vertebral* articulation, is not complete. It is much thickest in front and upon the sides, and radiates from its origin on the head of the ribs, whence it is usually called the *anterior radiating* or *stellate ligament.*

—There is also a small *inter-articulating ligament,* in this articulation, which passes from a ridge on the head of the rib to a corresponding line on the intervertebral substance. It thus divides the joint into two halves, each of which has a separate synovial membrane. This ligament does not exist where the ribs are attached to a single vertebra, as the first, eleventh and twelfth.

—The *costo-transverse* articulation, besides its feeble capsular ligament and synovial membrane connecting the tubercle of the rib with the facet of the transverse process, includes three other ligaments, the *internal transverse*, the *external transverse,* and the *middle costo-transverse.*

—The *internal transverse*, arises from the inferior margin of the transverse process, and is inserted into the upper margin of the neck of the rib below.

—The *external transverse,* arises from the extremity of the transverse process and is inserted into the corresponding rib, just beyond the tubercle.

—The *middle costo-transverse* ligament is extended between the neck of the rib and the contiguous transverse process. To be well seen it is necessary to saw longitudinally through the neck of the rib and its transverse process.

These ligaments permit the motions necessary for respiration, and restrain all others.

* The anterior ligaments of the vertebræ, and ligaments of the ribs. 1. The anterior common ligament. 2. The anterior costo-vertebral or stellate ligament. 3. The anterior costo-transverse ligament. 4. The inter-articular ligament connecting the head of the rib to the intervertebral substance, and separating the two synovial membranes of this articulation.

The connexion of the ribs anteriorly with their cartilages, is such as admits of no motion whatever between them; but the extremities of the cartilages are articulated with the sternum, at the pits on the edges of that bone. In many instances there is no appearance of synovia between the ends of the cartilages and the sternum; but this fluid is mostly to be found in the pits, on the lower extremity of the sternum.

—In the articulations between the cartilages of the ribs and the sternum, there is a synovial membrane, and two ligaments, *anterior* and *posterior*. These radiate from the sternal end of the cartilage, one over the anterior, the other over the posterior face of the sternum, and are blended with its periosteum, see fig. 53, p. 245.—

The Hip Joint.

Fig 61.*

The acetabulum is lined with cartilage; and the brim or margin of it is much enlarged, and the cavity deepened, by the addition of fibro-cartilaginous matter, which forms a regular smooth edge. This cartilaginous ring is continued across the upper part of the notch in the acetabulum; so that it completes the circular margin of the cavity, but leaves the under part of the notch open. This forms what is called the *cotyloid ligament.* The head of the os femoris is covered with cartilage, but the depression in it is still visible.

* The ligaments of the pelvis and hip-joint. 1. The lower part of the anterior common ligament of the vertebræ, extending downwards over the front of the sacrum. 2. The lumbo-sacral ligament. 3. The lumbo-iliac ligament. 4. The anterior sacro-iliac ligaments. 5. The obturator membrane. 6. Poupart's ligament. 7. Gimbernat's ligament. 8. The capsular ligament of the hip-joint. 9. The ilio-femoral or accessory ligament.

From this depression a strong round ligament *(ligamentum teres* or *rotundum)* see fig. 70, p. 270, arises, which appears to pass into the depression, near the centre of the acetabulum; but actually terminates in the lower edge of the cartilaginous ring or margin, where it crosses over the notch, and not in the bone. This ligament is in fact divided into two parts at its insertion; one passes out at the inferior part of the cotyloid notch and is inserted on the margin of the ischium; the other runs to the superior end of the notch, and besides being blended with the cotyloid ligament, is attached to the margin of the acetabulum. The thin *(synovial)* membrane with which this ligament is invested extends to the centre of the acetabulum, and has given rise to the opinion that the ligament was inserted in the bottom of the acetabulum.*

This ligament allows the head of the os femoris to rise out of the acetabulum, but it is probably torn in every luxation of the os femoris.

The *capsular ligament*, which contains these articulating parts, is the strongest in the body. It arises around the acetabulum, near the basis of the cartilaginous brim, but it does not adhere to the cartilaginous edge; and it is inserted into the os femoris, near the roots of the trochanters, so that it includes a large portion of the neck of the bone. It is not every where of the same thickness and strength; for, in various places, there are additional ligamentous fibres. The largest portion of these additional fibres appears to arise from the inferior anterior spinous process of the ilium. The capsular ligament is thinnest at its internal and posterior part.—The additional fibres which arise from the anterior inferior spinous process of the ilium constitute the *ilio-femoral*, or *accessory* ligament.

The synovial membrane forms the internal lamina of this ligament: it invests the articulating surfaces in the usual manner, and being reflected from the internal surface of the capsular ligament to the neck of the os femoris, it is in the place of periosteum to that part of the bone.

It seems probable that this membrane is so reflected and

* See motions of skeleton.

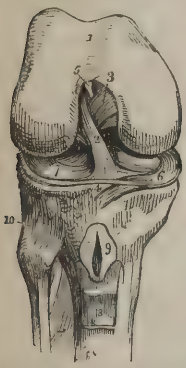
arranged, that the internal ligament is covered by it also, and of course, that this ligament is exterior to the synovial membrane.

There is a considerable quantity of adipose matter near the termination of the aforesaid internal ligament, which is also exterior to the synovial membrane: some of this can be pressed out of the acetabulum, at the vacuity in the notch under the cartilaginous margin.

Articulation of the Knee.

The synovial membrane of the knee joint is, in some places, without the support of a proper capsular ligament, or external lamen, so that it is easier distinguished in this articulation than in many others.

Fig. 62.*



It adheres firmly to the cartilaginous surfaces of the os femoris, tibia, and patella, and is reflected in the usual manner from one to the other of these surfaces. It arises closely from the edge of the cartilaginous surface at the top of the tibia; but on the anterior part of the os femoris, it is continued to some distance from the margin of the pulley-like surface, and the edges of the condyles. On each of the portions of the cartilaginous surfaces of the tibia is a cartilage of a semilunar form, so placed that its convex edge rests on the margin of the cartilaginous surface, and its concave edge is internal. These cartilages are

* The right knee joint laid open from the front, in order to show the internal ligaments. 1. The cartilaginous surface of the lower extremity of the femur with its two condyles; the figure 5 rests upon the external; the figure 3 upon the internal condyle. 2. The anterior crucial ligament. 3. The posterior crucial ligament. 4. The transverse ligament. 5. The attachment of the ligamentum mucosum; the rest has been removed. 6. The internal semi-lunar fibro-cartilage. 7. The external fibro-cartilage. 8. A part of the ligamentum patellæ turned down. 9. The bursa, situated between the ligamentum patellæ and the head of the tibia. It has been laid open. 10. The anterior superior tibio-fibular ligament. 11. The upper part of the interosseous membrane; the opening above this membrane is for the passage of the anterior tibial artery.

thick at their external, and very thin at their internal edges; so that they form two superficial concavities on the top of the tibia.

Their extremities are attached by ligaments to the central protuberance of the tibia, and their anterior extremities are also connected by a ligament to each other.

The synovial membrane is so reflected as to cover the whole surface of these cartilages, except the exterior edge, which is connected with the external ligaments of the articulation.

Fig. 63.*

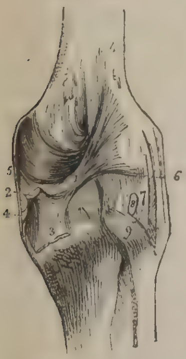
The use of these cartilages, is evidently to form concavities on the top of the tibia, for accomodating the condyles of the os femoris; and upon èxamination, they will not appear so anomalous as they do at first view, for there is a considerable analogy between them and the cartilaginous edges of the glenoid cavity and of the acetabulum. These are called the *semilunar cartilages.* The internal is but little more than a semicircle; the external is nearly circular in its shape.

The patella appears to project into the cavity of the joint,

* A longitudinal section of the left knee joint, showing the reflections of its synovial membrane. 1. The cancellous structure of the lower part of the femur. 2. The tendon of the extensor muscles of the leg. 3. The patella. 4. The ligamentum patellæ. 5. The cancellous structure of the head of the tibia. 6. A bursa situated between the ligamentum patellæ and the head of the tibia. 7. The mass of fat projecting into the cavity of the joint below the patella. * * The synovial membrane. 8. The pouch of synovial membrane which ascends between the tendon of the extensor muscles of the leg, and the front of the lower extremity of the femur. 9. One of the alar ligaments; the other has been removed with the opposite section. 10. The ligamentum mucosum left entire; the section being made to its inner side. 11. The anterior or external crucial ligament. 12. The posterior ligament. The scheme of the synovial membrane which is here presented to the student, is divested of all unnecessary complications. It may be traced from the saculus (at 8), along the inner surface of the patella; then over the adipose mass (7) from which it throws off the mucous ligament (10); then over the head of the tibia, forming a sheath to the crucial ligaments; then upwards along the posterior ligament and condyles of the femur, to the saccdus whence its examination commenced.

and its internal surface is very prominent; around the margin of this surface, and especially at the under part of it, the adipose substance found in joints is very abundant. On each side of the adipose mass, under the patella, is a plait of the synovial membrane, called *ligamentum alare minus*, and *majus;* and a process of the membrane, called *ligamentum mucosum* passes from the neighbourhood of the adipose mass to the os femoris between the condyles.

Fig. 64.*



These processes retain the adipose substance in its proper place, during the motions of the joint.

There are two very strong ligaments, called the *anterior* and *posterior crucial*, which arise from the middle protuberance of the tibia, one of which is inserted posteriorly into the corner face of the external condyle of the os femoris, and the other, into the outer face of the internal. These ligaments decussate each other partially, on which account the name *crucial* is applied to them. They are in a state of tension when the leg is extended, and prevent it from moving farther forward: when it is bended they are relaxed. They add greatly to the strength of the connexion between the os femoris and tibia.

These ligaments are generally supposed to be in the cavity of the joint; but the synovial membrane is reflected round them in such a manner that they are exterior to it.

In addition to the crucial ligaments, this articulation has the following external supports.

When the leg is extended, these ligaments are tense, they therefore prevent rotation in the extended state: when the

* Posterior view of the ligaments of the knee joint. 1. Posterior ligament of Winslow, connected by a tendinous expansion with 2, the tendon of the semi-membranous muscle; the latter is cut short. 3. The process of the tendon, which spreads out in the fascia of the popliteus muscle. 4. A process which is sent inwards beneath the internal lateral ligament. 5. The posterior part of the internal lateral ligament. 6. The long external lateral ligament. 7. Short external lateral ligament. 8. Tendon of popliteus cut short. 9. The posterior superior tibio-fibular ligament.

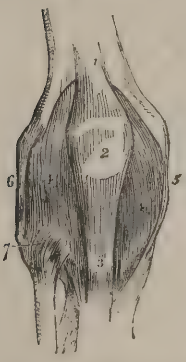
leg is bent, they are relaxed, and, therefore, admit of that motion.

1. *Two strong lateral ligaments*, one on each side of the knee; the *external* of which arises from the tubercle above the external condyle of the os femoris, and is attached to the fibula a little below its head; and the *internal*, from the upper part and tubercle of the internal condyle, and is inserted into the upper and inner part of the tibia.

2. The *posterior ligament*, or *ligament of Winslow*, whose fibres run obliquely from the external condyle to the back part of the internal side of the head of the tibia. This ligament also prevents the leg from being drawn too far forwards.

3. The connexion of the tendons of the extensor muscles of the leg, with this articulation, has a great effect upon it. Their insertion into the patella places them in the situation of the upper part of the anterior ligament, of which the very strong ligament, that passes from the lower margin of the patella to the tubercle of the tibia, is only the lower portion; while the patella may be considered as an inducted part of the ligament. The tendons of the ham-string muscles, also, serve to strengthen the articulation on the back and sides.

Fig. 65.*



—The fascia lata of the thigh as it passes down upon the leg, is thickened by a process of the extensor tendons, and forms a strong external investment or involucrum to the knee joint. It constitutes in fact a sort of capsular ligament to the joint; it closely embraces the patella and its ligaments, covers in and is partly blended with the lateral ligaments, and is firmly attached to the condyles. At the posterior part of the joint, it forms a thin membrane, and can scarcely be traced. Its place is there

* The anterior view of the ligaments of the knee joint. 1. The tendon of the quadriceps extensor muscle of the leg. 2. The patella. 3. The anterior ligament, or ligamentum patellæ, near its insertion. 4, 4. The synovial membrane. 5. The internal lateral ligament. 6. The long external lateral ligament. 7. The anterior superior tibio-fibular ligament.

supplied by the posterior ligament. On either side of the ligament of the patella its inner face is in contact with the synovial membrane of the joint.—

Bursæ Mucosæ.

There are two of these in connection with the ligamentum patellæ; one of which is placed superficially between the ligament and the fascia lata. This is the seat of the enlargement by increase of secretion, known under the name of housemaid's knee. The other is placed between the tibia and the ligamentum patellæ, as seen in fig. 65.

Articulation of the Tibia and Fibula.—Superior Articulation.

The surfaces of the upper extremities of the tibia and fibula, which are articulated with each other, are very small. When the bones are in their natural position, these surfaces are nearly horizontal, that of the tibia looking down, and that of the fibula looking up: they are covered with cartilages, and have a synovial membrane. This articulation is supported by some ligamentous fibres, which have been called *anterior superior*, and *posterior superior ligaments;* it is strengthened also by the external lateral ligament of the knee, and by the tendon of the biceps muscle which is inserted into the upper end of the fibula.

Inferior Articulation.

At their lower extremities, the cartilaginous crust, which, on each of them, forms part of the articulating surface with the astragalous, is turned up on their lateral surfaces which are in contact with each other; so that a small portion (equal in breadth only to one sixth of an inch) of the contiguous surfaces, is covered with cartilage; the other parts of these surfaces which are very considerable, are attached to each other by the intervention of fibrous or membranous matter, and there is very little motion of the bones on each other.

There are very strong external ligaments, called the *anterior*

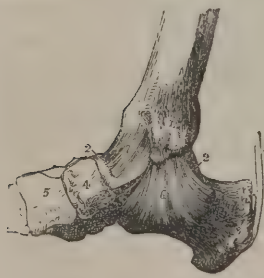
Fig. 66.*

inferior, and *posterior inferior*, which connect the fibula to the tibia; and from the posterior surface of the end of the fibula, a ligament called the *transverse*, passes to the posterior part of the internal malleolus, which resembles the marginal ligament of the glenoid cavity and acetabulum; for it enlarges the articulation with the astragalus, while it serves as a ligament to the tibia and fibula. There are some short, strong fibres passing below and between the opposite surfaces of the tibia and fibia, called the *inferior interosseous ligament*.

Articulation of the Leg, Foot, and Ankle Joint.

It should be observed that the tibia and fibula are so firmly connected with each other below, that they may be considered as forming but one member of this articulation.

Fig. 67.†



The varied surfaces formed by the tibia and fibula and their two melleolar processes, and by the astragalus with its two lateral facets, where it is contiguous to them, are invested with the usual apparatus of articulation. The synovial fluid is generally observed to be very redundant in this joint. There are four ligaments which enter into this articulation.

A triangular band of fibres called the *internal lateral liga-*

* A posterior view of the ankle joint. 1. The lower part of the interosseous membrane. 2. The posterior inferior ligament connecting the tibia and fibula. 3. The transverse ligament. 4. The internal lateral ligament. 5. The posterior fasciculus of the external lateral ligament. 6. The middle fasciculus of the external lateral ligament. 7. The synovial membrane of the ankle joint. 8. The os calcis.

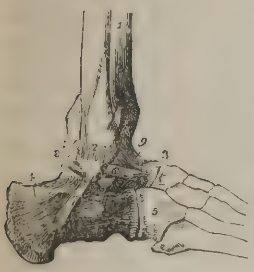
† An internal view of the ankle joint. 1. The internal malleolus of the tibia. 2, 2. Part of the astragalus; the rest is concealed by the ligaments. 3. The os calcis. 4. The scaphoid bone. 5. The internal cuneiforme bone. 6. The internal lateral or deltoid ligament. 7. The anterior ligament. 8. The tendo Achillis; a small bursa is seen interposed between this tendon and the tuberosity of the os calcis.

ment passes downwards from the tibia at the internal malleolus, and is inserted into the inside of the astragalus, and also into the os calcis and naviculare. Some of the fibres are blended with those of the sheath for the tendon of the flexor communis; and some of them have a radiated arrangement, in consequence of which this has been called the *deltoid ligament.*

From the fibula three ligaments arise, spoken of collectively as one ligament, *external lateral,* (*ligamentum triquetrum.*) The middle fasciculus, which is strong and thick, passes downwards from the end of that bone, to be inserted into the outside of the os calcis. The *anterior* fasciculus passes forwards, and is attached to the astragalus. The *posterior* fasciculus passes backwards, and is attached to the posterior part of the astragalus. —The *anterior* ligament is a thin membranous layer, in contact with the synovial membrane, it passes from the anterior margin of the tibia and is inserted into the anterior portion of the astragalus, near the articular surface. No well marked *posterior* ligament exists at this articulation. The transverse ligament supplies its place.

Articulation of the Astragalus and Os Calcis.

Fig. 68.*



The astragalus is attached firmly to the os calcis by very strong and short ligamentous fibres, which arise from the fossa on its under surface, and are inserted into the fossa between the upper articulating surfaces of the os calcis. This is called the *interosseous.* This ligament separates the posterior articulations of the astragalus and os calcis from the anterior. The posterior articulation has a synovial membrane exclusively appropriated to it. The anterior articulation

* An external view of the ankle joint. 1. The tibia. 2. External malleolus of the fibula. 3, 3. Astragalus. 4. Os calcis. 5. Cuboid bone. 6. The anterior fasciculus of the external lateral ligament attached to the astragalus. 7. Its middle fasciculus attached to the os calcis. 8. Its posterior fasciculus attached to the astragalus. 9. The anterior ligament of the ankle.

is supplied by an extension of the membrane which invests the articulating surfaces of the astragalus and naviculare.

The connexion of the astragalus, with the os calcis is supported by the lateral ligaments of the ankle joint, and also by many irregular ligamentous fibres.

Articulation of the Astragalus with the Os Naviculare.

This articulation appears calculated for considerable motion, as well from the form of the two surfaces concerned in it, as the perfect state of their articulating investments. Their motions are restrained to a certain degree, by ligaments, which are situated on the upper and internal surfaces of the foot.

Fig. 69.*

—On the upper surface of the foot, is a thin broad ligament formed of parallel and oblique fibres, stretched from the upper and inner face of the astragalus to the upper surface of the scaphoides or naviculare; some of the fibres extend even to the cuneiforme bones.

—On the under surface of the foot, these bones are connected by two ligaments, *calcaneo-scaphoid internum, and externum.*

—The *internal* arises from the inner margin of the lesser apophysis of the os calcis, and runs obliquely forwards and inwards, to be inserted on the inner and under surface of the os naviculare. It is a strong ligament, and contributes much to the preservation of the arched form of the foot. On its under surface is a trochlea for the tendons of the flexor pollicis and

* The ligaments of the sole of the foot. 1. The os calcis. 2. The astragalus. 3. The tuberosity of the scaphoid bone. 4. The long calcaneo-cuboid ligament. 5. Part of the short calcaneo-cuboid ligament. 6. The internal calcaneo-scaphoid ligament. 7. The plantar tarsal ligaments. 8, 8. The tendon of the peroneus longus muscle. 9, 9. Plantar tarso-metatarsal ligaments. 10. Plantar ligament of the metatarso-phalangeal articulation of the great toe; the same ligament is seen upon the other toes. 11. Lateral ligaments of the metatarso-phalangeal articulation. 12. Transverse ligament. 13. The lateral ligaments of the phalanges of the great toe; the same ligaments are seen upon the other toes.

flexor longus digitorum. Below it is also in contact with the tendon of the tibialis posticus, and above with the head of the astragalus, which it in part supports.

—The *external* is at the outer side of the last; it arises from the under surface of the greater apophysis of the os calcis, and is inserted upon the under internal surface of the os naviculare.—

The ligaments which pass from the anterior internal extremity of the os calcis to the os naviculare, and support the head of the astragalus, ought to be observed with attention during the examination of this joint.

Articulation of the Os Calcis and Cuboides.

The articulating surfaces of this joint are arranged in the usual manner.

There are two additional ligaments: one placed on the upper, and the other on the under surfaces of the bones. The upper ligament is thin; but the under ligament is one of the strongest of the foot; and its fibres are blended with those which form the sheath for the tendon of the peroneus longus, as it passes along the groove in the cuboides.

—These ligaments are called the *superior and inferior calcaneo-cuboid.* The latter is by some considered as consisting of two ligaments, the *short* and *long.*

—The *superior* passes from the upper anterior surface of the os calcis to the adjoining surface of the os cuboides.

—The *inferior* is the strongest ligament of the foot. It arises from the inferior back part of the os calcis, and part of its fibres are inserted upon the oblique ridge or the tendon of the peroneus longus which traverses the under part of the os cuboides. This part is sometimes called the short *inferior calcaneo-cuboid* ligament. The greater part of the fibres of this ligament, pass beyond the ridge, and are inserted in fasciculi upon the basis of the third and fourth metatarsal bones. These subtend the groove, in which passes the tendon of the peroneus longus muscle, and constitute the *long inferior calcaneo-cuboid* ligament.

—The other bones of the foot are united in general by dorsal and plantar ligaments like the corresponding bones of the hand.—

CHAPTER VI.

OF PARTICULAR LIGAMENTS, AND OF THE SITUATION OF THE INDIVIDUAL BURSÆ MUCOSÆ.

Enumeration of the most important Ligaments, which have not been described.

Ligaments proper to the Scapula.

The *triangular ligament (ligamentum coraco-acromialis)* arises broad from the external surface of the coracoid process, and becomes narrower where it is fixed to the posterior margin of the acromion. It confines the tendon of the supra-spinatus muscle, and assists in protecting the upper and inner part of the joint of the humerus.

The *posterior ligament of the scapula (coracoid)* is sometimes double, and is stretched across the semilunar notch of the scapula, forming that notch into one or two holes for the passage of the superior posterior scapulary vessels and nerves. It also gives rise to part of the omo-hyoideus muscle.

The Interosseous Ligament of the Forearm,

Extends between the sharp ridges of the radius and ulna, filling up the greater part of the space between these two bones, and is composed of small fasciculi, or fibrous slips, which run obliquely downwards and inwards. Two or three of these, however, go in the opposite direction, and one of them, termed *oblique ligament* and *chorda transversalis cubiti*, is stretched between the tubercle of the ulna and under part of the tubercle of the radius. In different parts of the ligament there are perforations for the passage of blood-vessels from the fore to the back part of the bone, and a large opening is found at the upper part of it which is filled up by muscles. It prevents the radius from rolling too much outwards, and furnishes a commodious attachment for muscles.

Ligaments retaining the Tendons of the Muscles of the Hand and Fingers in their proper positions.

The *anterior annular ligament of the wrist* is stretched across from the projecting points of the pisiform and unciform bones, to the os scaphoides and trapezium, and forms an arch which covers and preserves in their places the tendons of the flexor muscles of the fingers.

The *vaginal ligaments of the flexor tendons* are five membranes, connecting the tendons of the sublimis, first to each other, andthen to those of the profundus; forming, at the same time, bursæ mucosæ which surround the tendons.

The *vaginal* or *crucial ligaments of the phalanges* arise from the ridges on the concave side of the phalanges, and run over the tendons of the flexor muscles of the fingers. Upon the body of the phalanges, they are thick and strong, to bind down the tendons, but over the joints they are thin, and have, in some parts, a crucial appearance, to allow the ready motion of the joints.

The *accessory ligaments of the flexor tendons of the fingers* are small tendinous fræna, arising from the first and second phalanges of the finger. They run obliquely forwards within the vaginal ligaments, terminate in the tendons of the two flexor muscles of the fingers, and assist in keeping them in their places.

The *posterior annular ligament of the wrist* is part of the aponeurosis of the forearm, extending across the back of the wrist, from the extremity of the ulna and os pisiforme to the extremity of the radius. It is connected with the small annular ligaments which tie down the tendons of the extensores ossis metacarpi et primi internodii pollicis, and the extensor carpi ulnaris.

The *vaginal ligaments* adhere to the last mentioned, and serve as sheaths and bursæ mucosæ to the extensor tendons of the hand and fingers.

The *transverse ligaments*, of the extensor tendons, are aponeurotic slips running between the tendons, near the heads of the metacarpal bones, and retaining them in their places.

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Ligaments on the Anterior part of the Thorax.

The *membrane proper to the sternum* is a firm expansion, composed of tendinous fibres running in different directions, and covering the anterior and posterior surfaces of the bone, being confounded with the periosteum.

The *ligaments of the cartilago ensiformis* are part of the proper membrane of the sternum, divided into strong bands, which run obliquely from the under and forepart of the second bone of the sternum, and from the cartilages of the seventh pair of ribs, to be fixed to the cartilago ensiformis. The ligaments covering the sternum serve considerably to strengthen that bone.

There are also *thin tendinous expansions* which run over the intercostal muscles at the fore part of the thorax, and connect the cartilages of the ribs to each other.

Ligaments of the Bones of the Pelvis.

Articulations of the vertebral column with the pelvis. The lowermost lumbar vertebra is articulated with the sacrum in the same manner as the vertebræ are articulated with each other, viz., by the common anterior and posterior ligaments of the spinal column, intervertebral substance, yellow elastic ligaments, capsular ligaments covering the oblique processes, and the interspinal ligaments. Two other ligaments connecting it with the bones of the pelvis, are denominated the ilio lumbar or lumbo-iliac ligament, and the sacro-vertebral or lumbar sacral ligament. From their direction they are sometimes called the *two transverse* ligaments of the pelvis.

The *ilio-lumbar*, (see fig. 61, p. 257,) arises from the point of the transverse process of the last lumbar vertebra, and from the oblique process below and is inserted for about two inches into the crest of the ileum just above its posterior superior spinous process. It sometimes from being blended with adipose substances presents the appearance of two distinct ligaments.

The *sacro-vertebral*, arises from the under part of the transverse process of the last lumbar vertebra, and is inserted into

the upper part of the base of the sacrum near the anterior ligament of the sacro-iliac articulation with which some of its fibres are blended.

The *proper ligaments* of the pelvis, are as follows, viz. 1. Those which connect the ilium and sacrum. 2. Those between the sacrum and ischium. 3. Those between the sacrum and coccyx, and 4. Those which join the two pubic bones together.

1. *Ligaments connecting the Ilium and Sacrum.*

A long flat *ligament* called the *sacro-spinous (lig. sacro-spinosum)* arises from the posterior superior spinous process of the os ilium descends obliquely and is inserted into the third and fourth transverse processes of the sacrum. It sometimes presents the appearance of two separate ligaments.

The ligaments which form the sacro-iliac junction are two in number, and are called anterior and posterior.

—The *anterior sacro-iliac ligament*, consists of a thin plane of short, strong ligamentous fibres, passing from bone to bone on the anterior face of the joint.

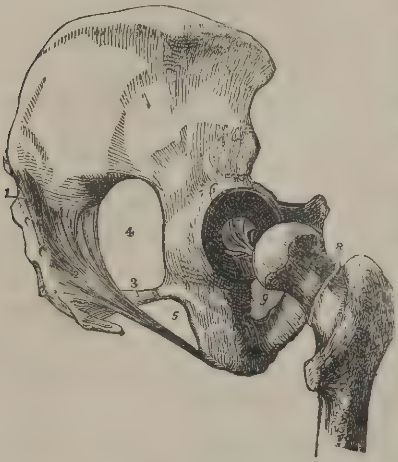
The *posterior sacro-iliac-ligament*, is the main stay of the articulation. It consists of many strong bundles of ligamentous fibres, which cross horizontally over the posterior part of the joint, and are attached by one extremity to the rough surface of the ilium immediately behind the joint, and by the other to two eminences on the lateral margin of the sacrum, as well as the rough surfaces of the bone between them.

2. *Ligaments connecting the Sacrum and Ischium.*

The *two sacro-ischiatic ligaments*, see fig. 70, are situated in the under and back part of the pelvis. They arise nearly in common from the transverse processes of the os sacrum, from the under and lateral part of that bone, and from the upper part of the os coccygis. The first, called the *external posterior* or *greater*, descends obliquely, to be fixed to the tuberosity of the os ischium. The other, called the *lesser*, *internal* or *anterior sacro-sciatic* or *sacro-ischiatic ligament*, runs transversely to be fixed to the spinous process of the os ischium. These

two ligaments assist in binding the bones of the pelvis, in supporting its contents, and in giving origin to part of its muscles.

Fig. 70.*



There are two *membranous productions* which are connected with the large sacro-ischiatic ligament, termed its *superior* and *inferior appendices.*

The *superior appendix*, which is tendinous, arises from the back part of the os ilium, and is fixed along the outer edge of the ligament, which it increases in breadth.

The *inferior* or *falciform appendix*, situated within the cavity of the pelvis, the back part of which is connected with the middle of the large external ligament, and the rest of it is extended round the curvature of the os ischium.

These two productions assist the large sacro-ischiatic ligament in furnishing a more commodious situation for, and insertion of, part of the gluteus maximus, and obturator internus muscles.

The large holes upon the back part of the os sacrum are also surrounded with various ligamentous expansions, projecting from one tubercle to another, and giving origin to muscular fibres, and protection to small vessels and nerves which creep under them.

* Ligaments of the pelvis and hip-joint. The view is taken from the side. 1. The oblique sacro-iliac ligament. The other fasciculi of the posterior sacro-iliac ligaments are not seen in this view of the pelvis. 2. The posterior sacro-ischiatic ligament. 3. The anterior sacro-ischiatic ligament. 4. The great sacro-ischiatic foramen. 5. The lesser sacro-ischiatic foramen. 6. The cotyloid ligament of the acetabulum. 7. The ligamentum teres. 8. The cut edge of the capsular ligament, showing its extent posteriorly as compared with its anterior attachment. 9. The obturator membrane only partly seen.

3. *Ligaments connecting the Sacrum and Os Coccygis.*

A general covering is sent down from the ligaments of the os sacrum, which spreads over and connects the different pieces of the os coccygis together, allowing considerable motion, as already mentioned, in the description of this bone. This forms what is called the *anterior* and *posterior coccygeal* ligaments.

The *posterior longitudinal ligaments of the os coccygis* descend from those upon the dorsum of the os sacrum, to be fixed to the back part of the os coccygis. The ligaments of this bone prevent it from being pulled too much forwards by the action of the coccygeus muscle, and they restore the bone to its natural situation, after the muscle has ceased to act.

4. *Ligaments connecting the Ossa Pubis.*

A *ligamentous fibro-cartilage*, resembling in structure the intervertebral substance, unites the two ossa pubis so firmly together at their symphysis as to admit of no motion, excepting in the state of pregnancy, when it is frequently found to be so much softened as to yield a little in the time of delivery.

—There are a few transverse ligamentous fibres on the front part of the symphysis pubis, called the *anterior pubic ligament.* These interlace in front of the symphysis.

—There are also a few irregular fibres on the posterior face of the articulation crossing from bone to bone, called the *posterior pubic ligament.*

—The *sub*, or *interpubic ligament* occupies the summit of the arch of the pubis. It is about half an inch in breadth, and passes from the crus of the pubis of one side to that of the other.—

—A thick strong band of fibres is found crossing from bone to bone, on their superior face, and filling up the inequalities which exist there ; it is called the *superior pubic ligament.*

The *obturator membrane*, or *ligament of the foramen thyroideum*, adheres to the margin of the foramen thyroideum, and fills the whole of that opening, excepting the oblique notch at

its upper part for the passage of the obturator vessels and nerve. It assists in supporting the contents of the pelvis, and in giving origin to the obturator muscles. See fig. 61, p. 257.

The *interosseous ligament of the leg* fills the space between the tibia and fibula like the interosseous ligament of the fore-arm, and is of a similar structure; being formed of the oblique fibres, and perforated in various places for the passage of vessels and nerves.

At the upper part of it there is a large opening, where the muscles of the opposite sides are in contact; and where vessels and nerves pass to the fore part of the leg.

It serves chiefly for the origin of part of the muscles which belong to the foot.

Ligaments retaining the Tendons of the Muscles of the Foot and Toes in their proper position.

The *annular ligament of the tarsus* is a thickened part of the aponeurosis of the leg, splitting into superior and inferior portions, which bind down the tendons of the extensors of the toes upon the forepart of the ankle.

The *vaginal ligament of the tendons of the peronei muscles,* behind the ankle is common to both, but divides at the outer part of the foot, and becomes proper to each. They preserve the tendons in their places, and are the bursæ of these tendons.

The *laciniated ligament* arises from the inner ankle, and spreads in a radiated manner, to be fixed partly in the cellular substance and fat, and partly to the os calcis, at the inner side of the heel. It encloses the tibialis posticus and flexor digitorum longus.

The *vaginal ligament of the tendon of the extensor proprius pollicis* runs in a crucial direction.

The *vaginal ligament of the tendon of the flexor longus pollicis* surrounds this tendon in the hollow of the os calcis.

The *vaginal* and *crucial ligaments of the tendons of the flexors of the toes* inclose these tendons on the surfaces of the phalanges, and form their bursæ mucosæ.

The *accessory ligaments of the flexor tendons of the toes, as in*

the fingers, arise from the phalanges, and are included in the sheaths of the tendons in which they terminate.

The *transverse ligaments of the extensor tendons* run between them, and preserve them in their places behind the roots of their toes.

Enumeration of the most important Bursæ Mucosæ.

Those about the articulation of the Shoulder are situated,

1. Under the clavicle, where it plays upon the coracoid process.

2. Between the triangular ligament of the scapula and the capsular ligament of the humerus.

3. Between the point of the coracoid process and capsular ligament of the humerus.

4. Between the tendon of the subscapularis muscle and capsular ligament of the humerus, frequently communicating with the cavity of that joint.

5. Between the origin of the coraco-brachialis and short head of the biceps muscles, and capsular ligament of the humerus.

6. Between the tendon of the teres major and the os humeri, and upper part of the tendon of the latissimus dorsi.

7. Between the tendon of the latissimus dorsi and os humeri.

8. Between the tendon of the long head of the biceps flexor cubiti and the humerus.

The Bursæ marked 3 and 5 are sometimes absent.

Near the articulation of the Elbow there are,

1. With a *peloton* of fat, between the tendon of the biceps and tubercle of the radius.

2. Between the tendon common to the extensor carpi radialis brevior, extensor digitorum communis, and round head of the radius.

3. A small bursa, between the tendon of the triceps extensor cubiti and olecranon.

On the Forearm and Hand are situated,

1. A very large bursa surrounding the tendon of the flexor pollicis longus.

2. Four long bursæ lining the sheaths which enclose the tendons of the flexors upon the fingers.

3. Four short bursæ on the forepart of the tendons of the flexor digitorum sublimis in the palm of the hand.

4. A large bursa between the tendons of the flexor pollicis longus, the forepart of the radius, and capsular ligament of the os trapezium.

5. A large bursa between the tendons of the flexor digitorum profundus, and the forepart of the end of the radius, and capsular ligament of the wrist.

These two last mentioned bursæ are sometimes found to communicate with each other.

7. A bursa between the tendon of the flexor carpi radialis and os trapezium.

8. Between the tendon of the flexor carpi ulnaris and os pisiforme.

9. Between the tendon of the extensor ossis metacarpi pollicis and radius.

10. A large bursa common to the extensores carpi radiales, where they cross behind the extensor ossis metacarpi pollicis.

11. Another common to the entensores carpi radiales, where they cross behind the extensor secundi internodii pollicis.

12. A third, at the insertion of the tendon of the extensor carpi radialis brevior.

13. A bursa for the tendon of the extensor secundi internodii pollicis, which communicates with the second bursa common to the extensores carpi radiales.

14. Another bursa between the tendon of the extensor secundi internodii pollicis and metacarpal bone of the thumb.

15. A bursa between the tendons of the extensor of the fore, middle, and ring fingers, and ligament of the wrist.

16. For the tendons of the extensor of the little finger.

17. Between the tendon of the extensor carpi ulnaris and ligament of the wrist.

Upon the Pelvis and upper part of the Thigh there are,

1. A very large bursa between the iliacus internus and psoas magnus muscles, and the capsular ligament of the thigh bone.

2. One between the tendon of the pectinalis muscle and the thigh bone.

3. Between the gluteus medius and trochanter major, and before the insertion of the tendon of the pyriformis.

4. Between the tendon of the gluteus minimis and trochanter major.

5. Between the gluteus maximus and vastus externus.

6. Between the gluteus medius and pyriformis.

7. Between the obturator internus and os ischium.

8. An oblong bursa continued a considerable way between the obturator internus, gemini, and capsular ligament of the thigh bone.

9. A small bursa at the head of the semimembranosus and biceps flexor cruris.

10. Between the origin of the semitendinosus and that of the two former muscles.

11. A large bursa between the tendon of the gluteus maximus and root of the trochanter major.

12. Two small bursæ between the tendon of the gluteus maximus and thigh bone.

About the Joint of the Knee are,

1. A large bursa behind the tendon of the extensors of the leg, frequently found to communicate with the cavity of the knee joint.

2. Behind the ligament which joins the patella to the tibia, in the upper part of the cavity of which a fatty substance projects.

3. Between the tendons of the sartorius, gracilis, semitendinosus, and tibia.

4. Between the tendons of the semimembranosus and gemellus, and ligament of the knee. This bursa contains a small one within it, from which a passage leads into the cavity of the joint of the knee.

5. Between the tendon of the semimembranosus and the internal lateral ligament of the knee, from which also there is a passage leading into the joint of the knee.

6. Under the popliteus muscle, likewise communicating with the cavity of the knee joint.

About the Ankle there are,

1. A bursa between the tendon of the tibialis anticus, and under part of the tibia and ligament of the ankle.

2. Between the tendon of the extensor proprius pollicis pedis, and the tibia and capsular ligament of the ankle.

3. Between the tendons of the extensor digitorum longus, and ligament of the ankle.

4. Common to the tendons of the peronei muscles.

5. Proper to the tendon of the peroneus brevis.

6. Between the tendon achillis and os calcis, into the cavity of which a *peloton* or mass of fat projects.

7. Between the os calcis and flexor pollicis longus.

8. Between the flexor digitorum longus and the tibia and os calcis.

9. A bursa between the tendon of the tibialis posticus and the tibia and astragalus.

On the Sole of the Foot are also,

1. A second bursa for the tendon of the peroneus longus, with an oblong peloton of fat within it.

2. One common to the tendon of the flexor pollicis longus, and that of the flexor digitorum profundus, at the upper end of which a fatty substance projects.

3. Another for the tendon of the tibialis posticus.

4. Several for the tendons of the flexors of the toes.

PART III.

MYOLOGY.

CHAPTER VII.

GENERAL ANATOMY OF MUSCLES.*

THAT soft, fibrous, red-coloured substance, which constitutes so large a proportion of the volume of the more perfect animals, is called *Flesh* or *Muscle.*

By the contraction of this substance, the spontaneous motions of animals are produced ; and, on this account the fibres which compose it have long been regarded with particular attention.

Muscular fibres are not only arranged in those regular masses on the trunk and limbs of the body, which are so familiar to us by the name of *muscles*, but they also exist in some of the most important viscera, and produce the internal, as well as the external motions of animals.

—Muscles have been divided in man, and the superior animals, into two classes. The *first* class consists of those which produce the external motions of the body, and are placed exteriorly; these contract under the influence of the will, are the agents by which are executed the animal or voluntary functions which place the animal in relation with the exterior world, and are called the *muscles of animal life*, *muscles of the life of relation*, *voluntary muscles*, etc. These form by far the largest portion of the whole mass, and are attached in general, by one or both extremities to the skeleton. They are solid,

* Muscles were first named according to their figure and situation, in 1587, by Jacques Dubois, surnamed Sylvius, a member of the Faculty of Medicine, in Paris.—H.

that is, have no cavity in their interior, and vary much in their size. The *second* class consists of those placed in the interior of the body, and which effect the movements requisite in the various processes of nutrition and generation. These are not under the control of the will, and are called the *muscles of organic life, muscles of the life of nutrition, involuntary muscles,* etc. They are generally membraniform, and assist in forming the hollow organs, as in the heart, digestive canal, uterus and bladder. With the exception of those of the heart, the fibres of this class of muscles are of a pale colour, and some entirely colourless. A few of the muscles of animal life, as those of the ears and some of those of the face, are likewise faintly coloured, and are considered by Isenflam,* as existing even in the adult in a state of rudimental developement, as their colour and functions are found much more fully manifested in some quadrupeds.†

—The muscles in the inferior grades of animals appear to exist in a rudimental condition, and become more and more numerous, and of a colour more and more red generally, as we advance upwards from the zero point of the animal scale. In the developement of the human fœtus they seem to undergo analogous changes.

—They present themselves during the three first months of fœtal life, as gelatinous or viscous masses, very slightly tinged with yellow, and with thin tendons, according to Isenflam,

* Anatomische Untersuchungen, by H. F. Isenflam, Professor at the University of Dorpat.

† This physiological division of the muscles into two classes, after Bichat, is eminently useful to the student, in enabling him to simplify and generalise his studies of the muscular system; one class is not, however, wholly separate from the other. Between, is interposed another subdivision of muscles, called the Respiratory of Sir C. Bell, which with the muscles of the pharynx and œsophagus, might be considered as a third or mixed class of muscles, as they execute certain motions involuntarily and unconsciously to the individual, and yet are under the influence of the will to perform motions for other purposes or to execute the same motions more rapidly or more slowly. Thus, for instance, the muscles of respiration which carry on the process of breathing during sleep, produce involuntary sneezing, coughing and crying; and when placed under the influence of the will are made to elicit the voice, etc.—P.

already apparent in the flexors and extensors of the fingers and toes.

—At the end of the fourth or fifth month, the muscles present a reddish aspect, and at the period of birth, though they may be readily dissected from each other, they are very soft, and of a colour much less deep than those of the adult.—

Muscular fibres are connected to each other by cellular membrane. This membrane surrounds each muscle; and its various lamina, gradually diminishing in thickness, pass between the different bundles of fibres, and the different fibres of which each muscle is composed.

The fibres of muscles, when examined with magnifying glasses, appear to be composed of fibrillæ still smaller; and it has been supposed that this division of them extended beyond our powers of vision, even when assisted by microscopes: but so many errors have occurred in microscopical observations of very minute objects, and so much difference exists between the reports of different observers, that the subject at this time does not interest many persons; and very little attention is paid, by the anatomists and physiologists of the present day, to the opinions of those observers who supposed they had ascertained the structure of the ultimate fibrillæ.

—The cellular or reticular membrane investing the whole muscle, is called the *muscular sheath*. It is formed round every muscle of the body, but varies much in different places in regard to thickness and strength. Each of the many larger *fasciculi*, or bundles of fibres, (*lacerti*,) of which every muscle is obviously composed, is surrounded in like manner by processes sent inwards from the sheath, and is a perfect, though diminutive representative of the entire muscle.

—This secondary sheath surrounding the *fasciculi*, sends processes likewise inwards, and invests and separates the individual *fibres* so called, or rather the *primitive fasciculi*, of which each larger fasciculus is formed. These *fibres* or *primitive fasciculi* themselves are again susceptible of subdivision into what are called the *ultimate muscular filaments*, between which, it is probable, though not susceptible of demonstration,

24*

the elementary particles of cellular tissue likewise pass. In the muscles of organic life, the cellular tissue is less abundant, but more dense than in those of animal life. In some parts, especially in the digestive canal it is so dense and resistant as to represent a sort of ligamentous tissue, and give attachment to muscular fibres.

—This delicate sheath surrounding the primary fasciculus, has been designated by Mr. Bowman as the *sarcolemma*, or the primitive cellular investment of the muscular fibres.—The term *myolemma* has been applied to the same structure by Mr. Wilson and Dr. Quain.

—The entire muscle thus appears naturally susceptible of *three* subdivisions. 1st. Into *fasciculi*, or bundles of fibres. These are the minutest subdivisions which can be made with the naked eye, without resort to boiling or other mechanical means. These are themselves collected into bundles, by septa which pass in from the general sheath of the muscles, but which are easily unravelled by a little dissection; so that what is at first sight mistaken by the student for a fasciculus, is in reality but a bundle of fasciculi. The size of each of these *fasciculi*, varies in the different muscles of the body, and occasionally in the same muscle, according to the number of fibres of which it is composed. 2d. Into *fibres* so called or the *primitive fasciculi*. These are rendered very apparent by boiling, as seen daily in culinary preparations, by which the muscular fibre is swoln, while the cellular envelope, at the same time softened and reduced to a gelatinous pulp, is readily burst. These fibres also vary in their thickness, some having a diameter three or four times as great as that of others, depending upon the number of elementary filaments—usually amounting to several hundred—of which it is composed. 3d. Into the *elementary, or ultimate muscular filaments*. These are wholly microscopical, are not uniform in their diameter in all muscles, those of organic life being much smaller, and vary considerably in the numbers taken to constitute the muscular fibres of different size.* Each

* Meckel. tom. i. p. 378.

of the muscular fibres, and also, each of the ultimate filaments, according to Prochaska and Rudolphi, extend the whole length of the fleshy part of the muscles, differing entirely in this respect from the ultimate structure of the bones.

—Anatomists do not agree in regard to the diameter assigned the ultimate muscular filament, and from its microscopical diminutiveness any measurement can be considered as little more than an approximation. They have been examined by Hook, Lewenhœck, Dehayde, Muys, and more recently still by Prochaska and others. According to Prochaska, they are generally straight and parallel with each other, flattened or prismatic, and of a diameter one-fifth of that of the red globules of blood. Autenreith supposed them equal to one-third of the diameter. Prevost and Dumas found them by their measurement, $\frac{1}{7477}$th part of an inch in diameter, five or six times smaller than the red globules of the blood, and nearly equal, as Müller also has asserted, to the diameter of the chyle globules, or to the central nuclei of the red globules of blood, which may be considered the most minute compound constituents of the economy.

—Much of this discordance of opinion, is probably owing to the examinations not having always been practised upon single and well isolated filaments. From more recent observations by Bauer and Home, Beclard, Prevost, and Dumas, H. Cloquet, and H. M. Edwards, the ultimate filament may be considered as identical in its structure with the particles of blood deprived of their colouring matter, of which the central globules *(nuclei)* form the filaments by being articulated end to end, by a sort of delicate jelly or mucus, which is probably the elementary form of the cellular tissue. The more recent microscopical measurements of Henle, Lauth, Ficinis, Bruns and others, agree in giving to the *ultimate* or *elementary muscular filament* of animal life, a diameter of $\frac{1}{18000}$th part of an inch. The diameter of the *primitive fasciculus*, commonly called muscular fibre, which is cylindrical in shape, is considered upon an average about $\frac{1}{400}$th part of an inch in diameter. Each one is marked by striæ or streaks, which pass transversely round

them, in slightly curved or wavy parallel lines from $\frac{1}{10000}$ to $\frac{1}{12000}$th of an inch apart.

—The nature of these striæ which belong solely to the muscles of animal life, are not well understood, whether they be delicate fibres wound round the primary fasciculi, mere wrinkles in its myolemma or sheath, or what seems more likely, depressions corresponding with the breaks between the globules or granules, which, appended end to end, constitute a primitive filament.

—The primitive fasciculus, or muscular fibre of organic life, which is solely under the influence of the ganglionic nervous system, is paler and softer than those of animal life; is not so regularly arranged in a longitudinal and parallel direction; and is less easily divided into its primitive filaments. Though each fibre is round if singly examined, the bundles which they form are flattened, composing muscular membranes, often two or three layers deap, the bundles crossing each other at different angles, and forming networks and gratings. The most remarkable character of the organic muscular fibre, is the existence in it here and there of swellings somewhat larger than the diameter of the fibre, and produced by the nuclei of the original nucleated cells from which the fibre was developed.*—

These fibrillæ have been represented as simple hollow tubes, as a series of globular vesicles, as continuations of arteries, as termination of nerves, as structures of rhomboidal bodies, and finally, as cellular.†

It is supposed by one of the latest observers, who appears to be entitled to great attention,‡ that the muscular fibres are not thus minutely divided: that a single fibre, when separated from

* For a more full and interesting account of these microscopical investigations, see Human Physiology, fourth edition, by R. Dunglison, M. D., Professor of the Institutes of Medicine and Medical Jurisprudence in Jefferson Medical College, &c. &c. Phila., 1841.—P.

† A statement of these descriptions, with reference to the publications in which they are contained, may be seen in the Elementa Physiologiæ of Haller, vol. iv.

‡ Carlysle, in the Croonian Lecture, London Philosophical Transactions, 1805, Part I.

the adhering extraneous substances, and viewed in a powerful microscope, is a solid cylinder, formed of a pulpy substance, irregularly granulated, and covered by a portion of the reticular membrane.

—The opinions of Sir A. Carlysle, are not at the present time, deemed of much weight in anatomy; subsequent researches having shown them to be full of empty and reckless speculation. Among those who believed the muscular fibre to be hollow, were Sink and Mascagni; the latter considered it as formed of little cylinders, the walls of which are composed of absorbent vessels and filled with a glutinous substance. More recently, Raspail *(Chimie Organique)* has adopted a view which appears a modification of, and no better founded than that of Mascagni. He considers each *fibre* formed of a bundle of cylinders, the cylinders made up of elongated vesicles, attached end to end, and having a spiral arrangement.—

The connexion of these fibres with the *blood-vessels* and *nerves*, is an important circumstance in the structure of muscles.

The arteries of muscles are very numerous; and they ramify minutely. They are accompanied by veins; and it appears, by the successful labours of Ruysch, that when these arteries are fully injected, they not only communicate with the veins, but also pour out some of their contents in a dew-like effusion in the muscle.*

—With the exception of some of the viscera, as the lungs and kidneys, there are few organs that receive as much blood as the muscles.

—The arteries that supply the muscles, enter them at all points. The larger trunks more generally enter at the middle of the muscle, and ramify towards each extremity, the branches being placed between the larger fasciculi or lacerti, so that the flow of blood, may be less impeded during muscular contraction; minute branches only passing into the structure of the fasciculi.

* See Ruysch's description of the 96th preparation in his Thesaurus Quartus; and of the 35th preparation in Thesaurus Decimus.

The veins which attend the arteries, are said by Bichat to have few valves. The free distribution of blood to the muscles, appears to be necessary to preserve them in a condition, healthy and capable of contraction. When the supply of blood is cut off by a ligature, the muscle gradually becomes paralysed, and does not regain its power, till it is again supplied by the anastomosing branches.

—The colour of the muscle does not seem dependent wholly on the blood, but in part at least on their own peculiar structure, as seen in many animals, where the flesh is white and the blood red; and in the muscles of organic life in man, many of which are colourless, though more vascular than those of animal life. —The *absorbent vessels* exist no doubt in all the muscles, but they are traced with difficulty. They have been found in the muscles of the tongue, face and diaphragm.*—

The blood-vessels must terminate, not in the cavities of the muscular fibres, but exterior to these fibres; otherwise the dew-like effusion, would not be apparent; and it is probable, that the red colour, which is so general in muscles, depends upon a portion of blood effused from these vessels, and not contained in them; for it has been observed by Bichat, that in drowned or strangled animals, black disoxygenated blood occupied all the vessels, while the florid colour of the muscles continued unchanged; which could not have been the case if the colour of the muscles was owing to the blood in the vessels.

That the colour of the red muscles is owing to blood, is rendered certain by the fact that this colour may be completely washed away while the fibrous structure of the muscle remains unchanged. From this also it may be inferred that the blood is exterior to the muscular fibre, and to the vessels likewise.

It is said by Sabatier, that the colour will likewise be completely removed, by injecting a large quantity of water through the arteries; this does not invalidate the inferences drawn from the other facts; for the water effused from the

* Vide Breschet, Sur le Systeme Absorbante. Paris, 1836.

extreme branches of the arteries must necessarily wash away the blood which was previously effused from the same branches.

The water with which muscles have been washed, appears as if some blood had been mixed with it; it contains albumen and gelatine, with some fibrine, and a peculiar extractive substance, as well as the red colouring matter.

The substance of the muscle, when thus separated from the above mentioned matter by washing, appears to be of the same nature with the fibrine of the blood: and after boiling some time in the water, it seems, like that substance, to consist of brown insoluble fibres which are brittle when dry.

When the great function of muscles is under consideration, nerves appear of more importance than blood-vessels.

The *nerves* appropriated to muscles of voluntary motion are more numerous than those appropriated to any other parts, except the organs of sense. They subdivide into very fine fibrillæ; and it is the opinion of one of the latest observers, that these fibrillæ become soft and transparent, and finally blended with reticular membrane which surrounds the muscular fibres.

It ought to be noted that muscles are indued with great sensibility, and that the smallest puncture cannot be made in them without exciting pain.

Of the Tendons.

Thus arranged, the fibres of muscles are most generally attached to tendons, which are inserted into the bones these muscles are intended to move. They are also, in some cases, inserted into tendinous membranes, and other parts necessary to be moved; but in all such instances these parts are perfectly passive; and the motion in which they are concerned is altogether produced by the contraction of the muscular fibres.

—The tendons appear to be formed of a continuation of the cellular membrane which envelopes the fibres of the muscles. The ultimate construction of muscles was shown in page 283, to consist of a multitude of filaments each one composed of a linear series of the muscular molecules; each of the molecules

being contained in a series of cells of the cellular tissue, all of which are continuous with each other. The muscular matter is found in general only in the middle part of the cellular tissue; the latter part is continued on at each extremity of the muscle, where it is compacted into a solid mass, presents a ligamentous appearance, and constitutes the tendons, or cords by which the muscles are attached to the periosteum covering the bone. Hence the tendons are continuous with, and must obey to a certain extent the contraction of every muscular fibre.

—The tendons exist under a great variety of forms: most generally round or cylindrical, sometimes flat, radiated, bifurcated, etc., but are always susceptible, by a little dissection, of being unfolded into a membrane. They have little vascularity, no sensation in a healthy state, no nerves having ever been traced into them, and are of a strength surpassing that of almost any other substance of equal size. They have a great affinity for phosphate of lime, especially in old persons, in whom it is not very unusual to find them ossified; and very frequently at all stages of life, we find developed in their substance sesamoid bones.

—The muscles are often from inanition or want of use much wasted away, the red muscular matter disappearing from the cells in which its particles are contained. The cells however remaining, if the system regains its vigour, or the muscles are brought into use, they are filled anew with the muscular molecules, and the muscle is restored to its former size, and its contraction will take place again with its usual force.

—From this mode of formation, it is evident that there must be an exact relation between the force of the muscle, and the strength of its tendons, even when the muscle is most fully developed. The size and power of the muscle is much dependent upon its use.

—The muscles of the legs in dancers, of the arms in blacksmiths, of the shoulders and back in porters, all obtain an increase of bulk from use, which still better fits them for the duties they have to perform. This is strongly exemplified in birds; the breast bone and muscles attached to it being more

strongly developed than those of the legs, in birds which are much upon the wing; the reverse taking place in the ostrich, cassowary and penguin, which employ the wings only as aids to the feet.—

Notwithstanding the great attention that has been paid to this important operation of muscular fibres, the immediate cause is yet unknown.

Muscular motion takes place under the following different circumstances:—

1st. When irritation or stimulus is applied directly to the muscular fibre.

2d. When irritation is applied to a nerve connected with the muscles.

3d. When it is induced by volition.

There are several causes of muscular action which cannot be arranged under either of these heads, although it is probable they are not essentially different; such as the motions of coughing and sneezing, of yawning, &c.

The immediate irritation of a muscle is effected by every mechanical process, which punctures, divides, lacerates or extends its fibres; by acrid, and, perhaps, other chemical and peculiar qualities of the substance applied to the muscles; by a sudden change of temperature; and by electricity and galvanism.

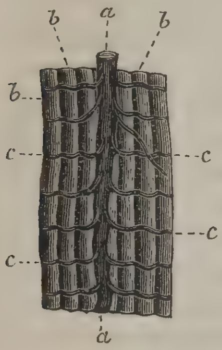
No satisfactory explanation has yet been made of the manner in which muscular contraction is excited, either by the above-mentioned agents, by irritation applied to a nerve, or by volition.

When a muscular fibre begins to contract, there is often the appearance of a slight tremor in it. It becomes hard and rigid: its length diminishes, and its diameter increases. If a muscle makes an effort to contract, when the parts to which its extremities are attached are prevented from moving towards each other, so that contraction cannot take place, the muscle will become hard and rigid notwithstanding.

—This tremor of the fibres, is called fibrillary agitation, *(agitation fibrillaire)* and is heard when a stethoscope is applied

over the belly of a muscle during its contraction, or when the end of the finger is introduced into the auditory meatus. During the contraction of a muscle there is no change in its colour, nor any increase in the amount of blood thrown into it by the arteries as was once supposed.

Fig. 70.*



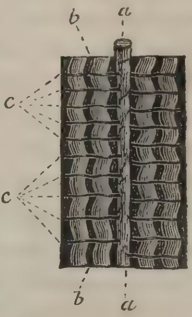
—With the aid of the microscope it is easy to distinguish the manner in which the contraction of a muscle is effected. Fig. 70, exhibits a magnified view of the muscular fibres in a state of relaxation. When they contract they form suddenly a number of zigzag flexions, or angular undulations, opposite each other, as seen in fig. 71, page 291, according to the observation of Edwards,† Prevost, and Dumas. By repeated experiments, these gentlemen have determined that the flexures of each fibre take place at certain determined points, and nowhere else. These points are precisely at the places where the nerve *a*, the trunk of which runs parallel with the muscular fasciculi, sends off its filaments to traverse the muscular fibres, at the spot where the angles of the undulations are formed. These nervous filaments after having continued their course for some time, are reflected in the form of loops, and return towards the brain, so as to constitute with that organ a continuous circle. —During the contraction of the muscle its extremities approach, for though the absolute length of the fibre remains the same, the distance between its extremities is diminished by the undulations. The will transmitted through the nerves is the usual stimulus, which excites the voluntary muscles to contraction. Galvanic electricity, or disease of nervous centres will produce the same result; that of the involuntary muscles, usually results from the impression made upon the organs, as

* *a*, Nerve. *b b*, Fasciculi of muscular fibres which are straight and parallel. *c*, Nervous filament which separates from the nerve *a*, and crosses at right angles, and at regular distances, the muscular fasciculi.

† Elements de Zoologie, etc., par M. H. Edwards. Paris, 1838.

by food in the stomach, blood in the heart, urine in the bladder, &c.—

Fig. 71.*



It has often been inquired whether the whole bulk of a muscle is diminished or increased by its contraction. It now seems generally agreed that the bulk is not increased; and, if there is any real diminution of the fibre itself, it is very small indeed.

The irritability of the muscular fibre, or its power of contracting upon the application of stimulus, exists in a greater degree in some muscular parts than others. It is suspended by the application of narcotic substances; and it remains, in many cases, a short time after the vital functions have ceased.

In a majority of cases a general contraction seems to take place in the last moments of life; and after death the body is stiff in consequence of it; all the movable parts being fixed in the precise situation in which they were when the vital motions ceased. The limbs being generally in a bended position at that time, if an attempt be made to extend them it will be very evident that the contracted state of the muscles impedes this extension. When this contraction is once overcome, the limbs continue perfectly flexible, and the muscles are ever after relaxed; but the force of contraction is sometimes so great that it will require a considerable exertion of strength to overcome it. This condition of the muscles, after death, although very common, is not universal: and some dead subjects are perfectly relaxed and flexible from the first cessation of the vital functions.

The force with which muscles contract exceeds greatly their inanimate power of cohesion. Thus, a muscle deprived of life, would be completely lacerated by a weight suspended from it, which it could readily raise by its contraction during life. This force of contraction is so great, that the tendo-achillis and the

* The same muscle at the moment of contraction, and *a b c*, indicates the same, as in Fig. 70.

patella have been repeatedly broken by the mere power of the muscles, inserted into them.

The rapidity with which the successive contractions of the same parts take place is extreme; and as a striking proof of it, the motions of the tongue, in rapid speaking or reading, are referred to by physiologists.

The extent or degree of muscular contraction, is in some cases, very great. In proof of this it was stated by the second Monro, that crude mercury, which passes so readily through the intestines, could not be carried along any parts of them whose position happened to be perpendicular, (as the colon on the right side when we stand,) unless the circular fibres of the intestine contract behind it to such a degree as to close completely the cavity of that tube.

An interesting question may be proposed here,—Whether the power of motion, as above described, is exclusively enjoyed by muscular fibres; whether these fibres must be supposed to exist in all those parts of the body which occasionally perform contraction?

It has often been inferred, that parts were muscular because they were capable of contraction; but the question above ought to be decided affirmatively before such inferences can be properly made.

The sac of the tænia hydatigena appears to be a membrane of a peculiar structure, very different from muscle; yet it is as capable of contracting as if it were perfectly muscular.*

The membrane of the urethra does not appear to be muscular in its structure; and yet it has been seen to protrude a bougie, which had passed near to the neck of the bladder, in a way that indicated regular successive contraction, throughout its whole extent.

The question above stated, may, therefore, be considered as not yet decided affirmatively.

Muscular fibres are situated very differently in different parts. They compose almost the whole substance of the heart, which

* See the Croonian Lecture by Mr. Home; London Philosophical Transactions for 1795, Part I. page 204.

is therefore called a hollow muscle. They also form one of the coats of the stomach and intestines, and of the urinary bladder.

In the muscles on the trunk and limbs, their arrangement is very various, being rectilinear, penniform, radiated, &c.

There are a great many short fibres, with an oblique direction, in some muscles of small volume, which have therefore great power and little motion, as in the semimembranosus.

—Contraction, though the only power that muscles appear to exercise, is found likewise existing to some extent, in other tissues of the body, where some effort and resistance is required in the performance of their functions, without the necessity of that perfect antagonism of action which muscles usually establish. There appears, in fact, to be a regular gradation in the changes of the condition of the muscular fibre. The muscles of animal life in man are the most fully developed, most highly coloured, and enjoy to the fullest extent, the powers of contraction. Their only vital action is that of contraction, which has been before explained, (see page 291,) which causes their ends to approach each other, by moving one or the other of the bones, to which the two ends of the muscles are attached. One of the bones is usually more readily moved than the other, and that is the action of the muscle as usually set down in books. But the student will do well to impress upon his mind, that this is not the only movement which the muscle can effect, and that if the part which it usually moves, becomes from some adventitious cause more solidly fixed than the other, as from a weight attached to it, or the opposing action of other muscles, the contraction of the muscle will produce a movement of the part, at which its other extremity is inserted. In this way the action of muscles is beautifully varied, and very complicated and useful movements are produced in the body, by what seems a very simple arrangement of the muscles. Thus the action of the great pectoral and latissimus dorsi muscles is usually to pull down the arms when they have been elevated by other muscles. But if the arms are thrown upwards, and the hands grasp some place above, as the limbs

of a tree, they then raise the body upwards towards the arms, and thus become the muscles used in climbing.

—In violent dyspnœa, arising from spasmodic croup, asthma, or other causes, the arms are frequently drawn upwards so firmly by the muscles at the top of the shoulders, that the pectoralis major and latissimus dorsi cannot pull them down. When they contract, therefore, their extremities are made to approach by raising the ribs to which they are in part attached, and thus they become muscles of forced inspiration.

—The muscles of animal life are arranged, so that each one has its antagonist, or opposing muscle. Thus, there are flexors to bend the limbs, and extensors to straighten them, supinators and pronators, elevators and depressors. The muscles, which are very numerous, and like the bones are variously estimated, from 368 by Chaussier, to 400 or more by other writers, and producing by their single action a great variety of movements, are yet combined together in pairs or much larger numbers, so as to extend beyond computation the variety of movements they are capable of producing. Thus the two muscles already named, one of which, when acting separately, draws the arm usually downwards and forwards, the other downwards and backwards, when combined together draw it down in the diagonal or middle line.

—The antagonism of the muscles is dependent upon their alternate contraction: the shortened or contracted muscle, is restored to its former length chiefly by the contraction of its antagonist, but partly also by the resiliency of the cellular tissue in its composition. They are also capable of acting to a certain extent in unison, and thus give firmness and steadiness to the limbs or other parts, and hold them in a fixed direction, as occurs habitually in walking or standing, or pointing with the arm.

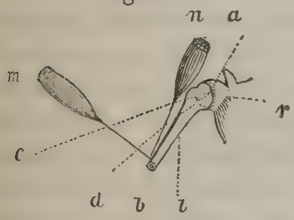
—The antagonising muscles do not appear to be equally balanced in regard to power; thus the most usual attitudes, in sleep, palsy or tetanus, where the muscles are uninfluenced by the will, is the extended position for the back, flexion to the arm in general, pronation to the fore arm, flexion to the lower

extremities and adduction to the foot. This is not dependent upon a difference in length, as was supposed by Borelli, but, according to Beclard, chiefly upon a difference in size, and the relative advantages of insertion upon the bones.

—Muscles have their tendons attached to the bones, in a manner to give them the least mechanical power, but to effect the greatest rapidity of motion; for, as has been observed by Archdeacon Paley, it is of far greater importance to man, to be able to carry his arm quickly to his head, than to raise several hundred weight more than he is now able to do: the two qualities could not well exist together. All that could be done to increase the power, without impairing the symmetry of the body, or diminishing the celerity of its movements, has been accomplished in endowing the muscles, with an extraordinary force of contraction, at least ten fold as great as the student would at first suppose it. The muscles are nearly all levers of the third order.

—The force with which a muscle contracts, depends upon its volume and the energy of the will, as well as some other circumstances. But the effect produced by the contraction will depend in a great measure upon the manner in which it is inserted upon the bone on which it acts.

Fig. 72.



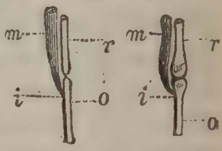
—Thus, all things being the same, the effect of the contraction will be the greater, in proportion as the muscle is less obliquely connected with the bone. Thus if the muscle *m*, figure 72, the force of which we suppose equal to 10, is fixed perpendicularly to the bone *l*, the extremity of which *a*, is movable upon the fulcrum point *r*, it will have to overcome only the weight of the bone, and will carry it from the position *a b*, into the direction of the line *a c*. But if this muscle acted obliquely upon the bone in the direction of the line *n b*, it would then tend to carry it in the direction of the line *b n*, and consequently to force it against the fixed articular surface *r*. This latter being

a fixed surface, the bone can only turn upon the point *r*, as upon a pivot, and the contraction of the muscle *n*, having the same force as the muscle *m*, would only be able to carry the bone in the direction *a d*, and would require a force equal to 40, or four times that of *m*, to raise it in the direction of the line *a c*.

—In the animal economy the muscles are inserted most usually, very obliquely, and consequently in a manner little favourable to the intensity of the result of their contraction. There is nevertheless a very happy contrivance, which tends to diminish the obliquity of their insertions, without marring the usefulness or symmetry of the limbs. It is the articular swellings at the extremities of the bones, which contribute also to the stability of the joints, the advantage of which is seen in fig. 73.

—The tendon *i* of the muscle *m*, Fig. 73, is inserted as is the case in general immediately below the articulation, upon the mobile bone *o*, in a direction more approaching the perpendicular, thus making the head of the bone a sort of pulley over which it acts, by which the effect of the contraction is considerably increased.

Fig. 73.



—A more striking instance is met with in the *deltoid muscle.* Baron Haller, has made an interesting calculation of the absolute force required to be exerted by the deltoid muscle, in order to raise a weight of 60 pounds at the elbow, reckoning the weight of the arm at five pounds of this. Its insertion is at an angle of 10 degrees upon the humerus, and at about one-third of the distance between the shoulder and elbow. The force requisite to raise a weight is exactly in the proportion of the *distance*, which the *weight* from the fulcrum bears to that of the *power* from the fulcrum. Thus, from the disadvantage of insertion, the force requisite to be exercised there is three times as great as it would be if inserted at the elbow; therefore the actual weight lifted, as far as the muscle is concerned, is equal to 180 pounds.

—But this is not all. The insertion of the muscle at an angle of 10 instead of 90 degrees, takes off the purchase in the

proportion, as mathematicians have calculated, which 173 bears to 1000. The augmented weight, or what is the same thing, the increase of power necessary to raise it, amounts, therefore, to no less than 1058, instead of the original 60 pounds. There is yet another source of loss of effect in its contraction, which requires great additional power in the muscle to counteract it. The tendon of the muscle is never directly continuous with the muscular fibres, and the loss of power is exactly in proportion to the obliquity of their junction. The manner of this loss is evinced, when we attempt to draw a body to us, at one time with a crooked, and at another, with a straight bar or stick. From this cause there would be a further loss of power of 228 pounds, which would augment the muscular energy, required to raise the 60 pounds, up to 1284, according to this physiologist.

—In the muscles of *organic life*, destined to act without the aid of the will, the system of antagonism, is much less perfectly developed. These muscles are hollow, and their fibres are arranged generally into layers, which cross each other at right angles, and contribute, to a certain extent, to produce this effect. The alternate contractions, of the auricles and ventricles of the heart, and of the uterus, though these organs have, properly speaking, no antagonist muscles, belong to this class. In some of the hollow organs, as the bladder, the contracted muscular fibres are expanded or antagonised, only by the matters which collect in their cavities.

—The muscles of organic life, with the exception of the heart, are of a pale or grayish white colour. Some of them are so thin, and of so pale a colour, that it is impossible to draw the line of distinction between them and cellular or aponeurotic tissue.

—There is a regular gradation between muscular and desmoid cellular tissue, now called *contractile fibre* or *contractile tissue*, and an occasional substitution of the one for the other, in parts that require elastic resistance, or firm support, that has been overlooked by anatomists. The yellow elastic ligamentous tissue, appears to be one medium between the muscular and ligamentous tissue. Comparative anatomy shows us that

parts formed in one animal of the elastic yellow tissue, are in others composed of muscular fibres. Thus, the suspensory ligaments of the sheath of the penis, are ligamentous in the horse, and muscular in the mule and bull. The middle coat of the arteries, which is composed of the elastic yellow tissue in man, is muscular in certain parts of the arterial system of the elephant.

—The kindred nature of these two tissues, is likewise strongly manifested by chemical analysis. The yellow elastic tissue consists chemically of albumen, osmazome and fibrine.* The thick yellow elastic ligament which supports the weight of the abdominal viscera in the horse, and others of the solipediæ, consists, in man, only of the fascia superficialis abdominis, and forms, as a late writer is disposed to think, the abdominal pouch, *(poche musculaire,)* of the didelphic animals, such as the opossum and kangaroo.

—The parietes of the urethra, which, in man, is strongly elastic, in the horse and many other animals is endowed with a strong coat of palish muscular fibres. On close examination it will be found in man, that the fibres of the contractile tissue which constitute the dartos muscle, are also extended so as to cover the corpus cavernosum penis and the urethra; over this latter organ it is not improbable that they sometimes become the seat of stricture. They run more or less parallel, and near to one another, over the scrotum, where they are interwoven with transverse fibres and bundles of cellular substance—or they form plexuses, as on the penis, which resemble the terminal plexuses of nerves, with this difference, that the individual fibres interlace and amalgamate.

—This same contractile fibre is found by the microscope to be interwoven in various places with the tissue of the skin, and that peculiar corrugation of the skin known under the name of goose flesh, is supposed to be produced by their agency. They act with such force upon the scrotum, as occasionally to make it hard as a ball, shrink it greatly in size, and force the testicles

* Consid. sur les aponeuroses abdom. servant d'introduction a l'histoire des Hernies, dans les Monodactyles, par Girard, fils.

up towards the inguinal rings. This contractile tissue enters as an element, into the constitution of the penis and clitoris, and probably also into that of the blood vessels, and the excretory ducts of the glands. When viewed under the microscope, the contractile fibre is found different from the round fibres of the common fibrous tissue; they are larger, redder, and possess a peculiar kind of transparency. The muscular fibres on the inner face of the prostate glands, and the muscles of Wilson on the membranous part of the urethræ seem to be allied to this class of tissue. This opinion seems borne out by the developement of the muscles in the fœtus, as previously quoted from Isenflam.

—Muscles are composed *chemically*, according to Berzelius, principally of fibrine; but they contain also albumen, gelatine, osmazome, phosphates of soda, ammonia and lime, carbonate of lime, and some free lactic acid. If the analysis is pushed farther—to the destruction of the flesh, there is developed a great quantity of nitrogen, hydrogen, oxygen and carbon, some iron, phosphorus, soda and lime.

CHAPTER VIII.

OF THE INDIVIDUAL MUSCLES.

Muscles of the Teguments of the Cranium.

The skin that covers the cranium is moved by a single broad digastric muscle, and one small pair.

1. *Occipito-Frontalis,*

Arises fleshy from the transverse protuberant ridge near the middle of the os occipitis laterally, where it joins with the temporal bone; and tendinous from the rest of that ridge backwards, opposite to the lateral sinus; it rises after the same manner on the other side. From thence it comes straight forwards, by a broad thin tendon, which covers the upper part of the cranium at each side, as low down as the attollens auris, to which it is connected, as also to the zygoma, and covers a part of the aponeurosis of the temporal muscle; at the upper part of the forehead it becomes fleshy, and descends with straight fibres.

Inserted into the orbicularis palpebrarum of each side, and into the skin of the eyebrows, sending down a fleshy slip between them, as far as the compressor naris and levator labii superioris alæque nasi.

Use. Pulls the skin of the head backwards; raises the eyebrows upwards; and, at the same time, it draws up and wrinkles the skin of the forehead.

2. *Corrugator Supercilii.*

Arises fleshy from the internal angular process of the os frontis, above the joining of the os nasi and nasal process of the superior maxillary bone; from thence it runs outwards, and a little upwards.

Inserted into the inner and inferior fleshy part of the occipito-frontalis muscle, where it joins with the orbicularis palpebrarum,

and extends outwards as far as the middle of the superciliary ridge.

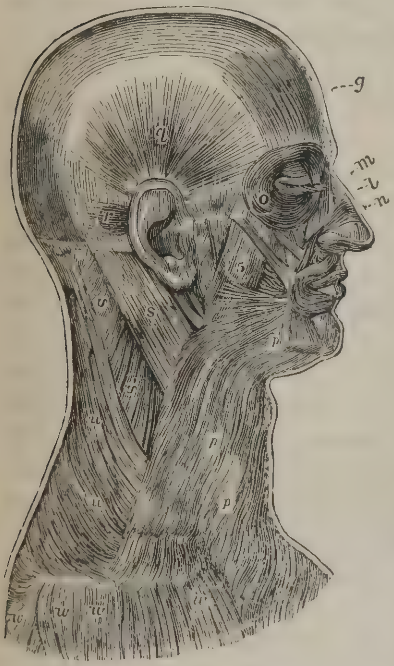
Use. To draw the eyebrow of that side towards the other, and make it project over the inner canthus of the eye. When both act, they pull down the skin of the forehead, and make it wrinkle particularly between the eyebrows.

Muscles of the Ear.

1. *Attollens Auris,*

Arises, thin, broad, and tendinous, from the tendon of the occipito-frontalis, from which it is almost inseparable, where it covers the aponeurosis of the temporal muscle.

Fig. 74.*



Inserted into the upper part of the ear, opposite to the antihelix.

Use. To draw the ear upwards, and make the parts, into which it is inserted, tense.

2. *Anterior Auris,*

Arises, thin and membranous, near the posterior part of the zygoma.

Inserted into a small eminence on the back of the helix, opposite to the concha.

Use. To draw this eminence a little forwards and upwards.

* Fig. 74.—*g*, Occipito-frontalis. *m*, Nasal slip of do. *n*, Compressor naris. *k*, Levator labii superioris alæque nasi. 5, Masseter. *q*, Attollens auris. *r*, Retrahentes auris, usually two in number. *p*, Platysma myoides. *s*, Sterno-cleido-mastoid. *u*, Trapezius. *v*, Splenius capitis. *i*, Splenius colli. *w*, Deltoid. The rest of the muscles known by references to the cuts No. 75, 76, 77.

3. *Retrahentes Auris,*

Arise, sometimes by three, but always by two distinct small muscles, from the external and posterior part of the root of the mastoid process, immediately above the insertion of the sterno-cleido-mastoid muscle.

Inserted into that part of the back of the ear which is opposite to the septum that divides the scapha and concha.

Use. To draw the ear back, and stretch the concha.

Muscles of the Eyelids.

The palpebræ or eyelids, have one muscle common to both, and the upper eyelid one proper to itself.

1. *Orbicularis Palpebrarum,*

Arises, by a number of fleshy fibres, from the outer edge of the orbitar process of the superior maxillary bone, and from a tendon near the inner angle of the eye; these run a little downwards, then outwards, over the upper part of the cheek, below the orbit covering the under eyelid, and surround the external angle, being loosely connected only to the skin and fat; run over the superciliary ridge of the os frontis, towards the inner canthus, where they intermix with those of the occipito-frontalis and corrugator supercilii; then covering the upper eyelid, they descend to the inner angle opposite to the inferior origin of this muscle, firmly adhering to the internal angular process of the os frontis, and to the short round tendon which serves to fix the palpebræ and muscular fibres arising from it.

Inserted, by the short round tendon, into the nasal process of the superior maxillary bone, covering the anterior and upper part of the lachrymal sac; which tendon can be easily felt at the inner canthus of the eye.

Use. To shut the eye, by drawing both lids close together, the fibres contracting from the outer angle towards the inner, press the eyeball, squeeze the lachrymal gland, and convey the tears towards the puncta lachrymalia.

—When the muscle is in strong action, its upper fibres

cause the skin of the forehead to descend, the lower ones elevate the integuments of the cheek. Like the other sphincters, this is a mixed muscle. The fibres which are supposed to be the proper voluntary portion, are those which correspond to the margin of the orbit, and are of a red colour. The involuntary fibres, form the thin portion which covers the lids, (*musculus ciliaris of Albinus*,) and are of a pale colour, like the muscles of organic life. They contract involuntarily while we are awake, in the action of winking, and during sleep in maintaining the lids closed.—

The *ciliaris* of some authors is only a part of this muscle covering the cartilages of the eyelids, called *cilia* or *tarsi*.

There is often a small fleshy strip, which runs down from the outer and inferior part of this muscle above the zygomaticus minor, and joints with the levator labii superioris alæque nasi.

2. *Levator Palpebræ Superioris,*

Arises from the upper part of the foramen opticum of the sphenoid bone, through which the optic nerve passes, above the levator oculi, near the trochlearis muscle.

Inserted, by a broad thin tendon, into the cartilage that supports the upper eyelid, named *tarsus*.

Use. To open the eye, by drawing the eyelid upwards; which it does completely, by being fixed to the tarsus, pulling it below the eyebrow, and within the orbit. *

Muscles of the Eyeball.

The muscles which move the globe of the eye are six, viz: four *straight*, and two *oblique*.

The four straight muscles very much resemble each other: all *Arising* by a narrow beginning, a little tendinous and fleshy, from the bottom of the orbit around the foramen opticum of the sphenoid bone, where the optic nerve enters, so that they

* There is no antagonist muscles provided especially to depress the lower lid. It depression is effected, according to the suggestion of Sir C. Bell, by the protrusion of the eyeball.—P.

may be taken out adhering to this nerve ; and all having strong fleshy bellies.

Inserted at the forepart of the globe of the eye into the anterior part of the tunica sclerotica, and under the tunica adnata, at opposite sides, which indicates both their names and *Use ;* so that they scarcely require any farther description than to name them singly. The union of thin tendinous insertions forms the *tunica albuginea.*

1. *Levator Oculi, (Rectus Superior,)*

Arises from the upper part of the foramen opticum of the sphenoid bone, below the levator palpebræ superioris, and runs forwards to be

Inserted into the superior and forepart of the tunica sclerotica, by a broad thin tendon.

Use. To raise up the globe of the eye.

2. *Depressor Oculi, (Rectus Inferior,)*

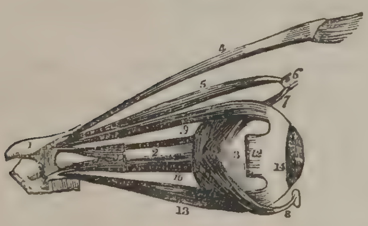
Arises from the inferior part of the foramen opticum.

Inserted opposite to the former.

Use. To pull the globe of the eye down.

3. *Adductor Oculi, (Rectus Internus,)*

*Fig. 75.**



Arises, as the former, between the obliquus superior and depressor, being from its situation, the shortest.

Inserted opposite to the inner angle.

Use. To turn the eye towards the nose.

* The muscles of the eyeball; the view is taken from the outer side of the right orbit. 1. A small fragment of the sphenoid bone around the entrance of the optic nerve into the orbit. 2. The optic nerve. 3. The globe of the eye. 4. The levator palpebræ muscle. 5. The superior oblique muscle. 6. Its cartilaginous pulley. 7. Its reflected tendon. 8. The inferior oblique muscle, the small square knob at its commencement is a piece of its bony origin broken off. 9. The superior rectus. 10. The internal rectus almost concealed by the optic nerve. 11. Part of the external rectus, showing its two heads of origin. 12. The extremity of the external rectus at its insertion; the intermediate portion of the muscle having been removed. 13. The inferior rectus. 14. The tunica albuginea, formed by the expansion of the tendons of the four recti.

4. *Abductor Oculi, (Rectus Externus,)*

Arises from the bony partition between the foramen opticum and foramen lacerum, being the longest from its situation; and is

Inserted into the globe opposite to the outer canthus.

Use. To move the globe outwards.

The oblique muscles are two:

Obliquus Superior, seu *Trochlearis*,

Arises, like the straight muscles, from the edge of the foramen opticum at the bottom of the orbit, between the levator and abductor oculi; from thence, runs straight along the pars plana of the ethmoid bone to the upper part of the orbit, where a cartilaginous trochlea is fixed to the inside of the internal angular process of the os frontis, through which its tendon passes, and runs a little downwards and outwards, enclosed in a loose membranous sheath.

Inserted by a broad thin tendon, into the tunica sclerotica, about half way between the insertion of the attollens oculi and optic nerve.

Use. To roll the globe of the eye, and turn the pupil downwards and outwards, so that the upper side of the globe is turned inwards, and the inferior part to the outside of the orbit, and the whole globe drawn forwards towards the inner canthus.

2. *Obliquus Inferior*,

Arises, by a narrow beginning, from the outer edge of the orbitar process of the superior maxillary bone, near its juncture with the os unguis; and running obliquely outwards, is

Inserted into the sclerotica, in the space between the abductor and optic nerve, by a broad and thin tendon.

Use. To draw the globe of the eye forwards, inwards, and downwards; and, contrary to the superior, to turn the pupil upwards towards the inner extremity of the eyebrow; at the same time, that the external part of the globe is turned towards

the inferior side, and the internal rolls towards the upper part.

The Muscle of the Nose.

There is only one muscle on each side that can be called proper to the nose, though it is affected by several muscles of the face.

Compressor Naris, (Triangularis seu *Transversalis Nasi,)*

Arises, by a narrow beginning, from the root of the ala nasi externally, where part of the levator labii superioris alæque nasi is connected to it; it spreads into a number of thin separate fibres, which run up along the cartilage in an oblique manner towards the dorsum of the nose, where it joins with its fellow, and is

Inserted slightly into the anterior extremity of the os nasi and nasal process of the superior maxillary bone, where it meets with some of the fibres descending from the occipito-frontalis muscle. *

Use. To compress the ala towards the septum nasi, particularly when we want to smell acutely; but, if the fibres of the frontal muscle, which adhere to it, act, the upper part of this thin muscle assists to pull the ala outwards. It also corrugates the skin of the nose, and assists in expressing certain passions.—It has been called by Columbus *dilatans nasi*, from a belief, in which, Bourgery coincides, that when it acts with its extremity upon the nose as the fixed point, it dilates the nostril. When the other extremity of the muscle is the fixed point, it compresses it.—

Muscles of the Mouth and Lips.

The mouth has nine pair of muscles, which are inserted into the lips, and a common one formed by the termination of these;

* The nasal slip of fibres descending from the occipito-frontalis, is sometimes spoken of as a distinct muscle, under the name of *Pyramidalis nasi.*

viz. three *above*, three *below*, three *outwards*, and the common muscle surrounds the mouth.

The three above are,

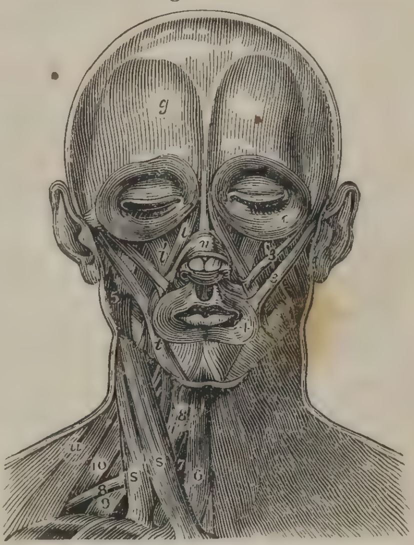
1. *Levator Anguli Oris*,

Arises, thin and fleshy, from the hollow of the superior maxillary bone, between the root of the socket of the first dens molaris and the foramen infra orbitarium.

Inserted into the angle of the mouth and under lip, where it joins with its antagonist.

Use. To draw the corner of the mouth upwards, and make that part of the cheek opposite to the chin prominent, as in smiling.

Fig. 76.*



2. *Levator Labii Superioris Alæque Nasi*,

Arises by two distinct origins: the first broad and fleshy, from the external part of the orbitar process of the superior maxillary bone which forms the lower part of the orbit, imme-

*Fig. 76.—*g*, Occipito-frontalis. *l*, Levator labii superioris alæque nasi. *l*, Levator anguli oris. *n*, Compressor naris. *o*, Orbicularis palpebrarum; the external palpebral ligament, seen on the right side, extending to the ear. 3 3, Zygomaticus major, and minor. 4, Orbicularis oris, with the slip to the lower part of the septum of the nose, called by Albinus, nasalis labii superioris. 5, Masseter. *t*, Depressor anguli oris. *s s*, Sternal and clavicular portions of the sterno-cleido-mastoid. *u*, Trapezius seen at its upper part. 6, Sterno-hyoid. 7, Sterno-thyroid. 8, Omo-hyoid. 9, Scalenus anticus. 10, Scalenus medius.

diately above the foramen infra-orbitarium; the second portion arises from the nasal process of the superior maxillary bone, where it joins the os frontis at the inner canthus, descending along the edge of the groove for the lachrymal sac.

The first and shortest portion is

Inserted into the upper lip and orbicularis labiorum; the second and longest, into the upper lip and outer part of the ala nasi.

Use. To raise the upper lip towards the orbit, and a little outwards; the second portion serves to draw the skin of the nose upwards and outwards, by which the nostril is dilated.

3. *Depressor Labii Superioris Alæque Nasi,*

Arises, thin and fleshy, from the os maxillare superius, immediately above the joining of the gums with the two dentes incisores and the dens caninus; from thence it runs up under part of the levator labii superioris alæque nasi.

Inserted into the upper lip and root of the ala nasi.

Use. To draw the upper lip and ala nasi downwards and backwards.

The three below are,

1. *Depressor Anguli Oris,*

Arises, broad and fleshy, from the lower edge of the maxilla inferior, at the side of the chin, being firmly connected to that part of the platysma myoides, which runs over the maxilla to the angle of the mouth, to the depressor labii inferioris within, and to the skin and fat without, gradually turning narrower; and is

Inserted into the angle of the mouth, joining with the zygomaticus major and levator anguli oris.

Use. To pull down the corner of the mouth.

2. *Depressor Labii Inferioris,*

Arises, broad and fleshy, intermixed with fat, from the infe-

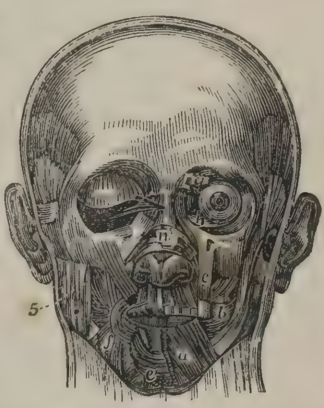
rior part of the lower jaw next to the chin; runs obliquely upwards, and is

Inserted into the edge of the under lip, extends along one half of the lid, and is lost in its red part.

Use. To pull the under lip and the skin of the side of the chin downwards, and a little outwards.

3. *Levator Labii Inferioris,*

Fig. 77.*



Arises, from the lower jaw, at the roots of the alveoli of two dentes incisores and of the caninus; is

Inserted into the under lip and skin of the chin.

Use. To pull the parts, into which it is inserted, upwards.

The three outward are,

1. *Buccinator,*

Arises, tendinous and fleshy, from the lower jaw, as far back as the last dens molaris and forepart of the root of the coronoid process; fleshy from the upper jaw, between the last dens molaris and pterygoid process of the sphenoid bone; from the extremity of this process it arises tendinous, being continued between both jaws to the constrictor pharyngis superior, with which it joins; from thence, proceeding with straight fibres, and adhering close to the membrane that lines the mouth, it is

Inserted into the angle of the mouth within the orbicularis oris.

Use. To draw the angle of the mouth backwards and outwards, and contract its cavity, by pressing the cheek inwards, by which the food is thrust between the teeth. —The bucci-

*Fig. 18.—*a*, Depressor labii inferioris. *b*, Buccinator. *c*, Levator anguli oris. *e*, Levator labii inferioris (levator menti;) this will be best seen in dissection by inverting the lip and dissecting off the mucous membrane. *f*, Depressor anguli oris. 5, Masseter. *g*. Tendon of the superior or internal oblique muscle of the eye, after it passes its trochlea. *h*, Inferior oblique.

nator acts principally in front on the commissure of the lips, which it draws backwards horizontally, increasing transversely the aperture of the mouth, and throwing the cheek into the vertical folds, so conspicuous in old age. It thus antagonises the orbicularis oris. If both these muscles act together, the lips are extended and pressed against the teeth. When the cavity of the mouth is distended with air or liquids, the fibres of this muscle are protruded and curved. If the muscle now acts, the fibres become straightened, and the fluid is expelled from the mouth, suddenly or gradually, according to the resistance made by the orbicularis.

—This muscle assists also in mastication and deglutition, by pressing the food from between the cheek and gums into the cavity of the mouth.—

2. *Zygomaticus Major,*

Arises, fleshy, from the os malæ, near the zygomatic suture.

Inserted into the angle of the mouth, appearing to be lost in the depressor anguli oris and orbicularis oris.

Use. To draw the corner of the mouth and under lip towards the origin of the muscle, and make the cheek prominent, as in laughing.

2. *Zygomaticus Minor,*

Arises from the upper prominent part of the os malæ, above the origin of the former muscle; and, descending obliquely downwards and forwards, is

Inserted into the upper lip, near the corner of the mouth, along with the levator anguli oris.

Use. To draw the corner of the mouth obliquely outwards and upwards towards the external canthus of the eye.

The common muscle is the

Orbicularis Oris.

This muscle is, in a great measure, formed by the muscles that move the lips; the fibres of the superior descending, those

of the inferior ascending, and decussating each other about the corner of the mouth, run along the lip to join those of the opposite side, so that the fleshy fibres appear to surround the mouth like a sphincter.

Use. To shut the mouth, by contracting and drawing both lips together, and to counteract all the muscles that assist in forming it.

There is another small muscle described by Albinus, which he calls *Nasalis labii superioris;* but it seems to be only some fibres of the former connected to the septum nasi.

—The orbicularis, possesses a very varied and extensive action, and may act as a whole or in parts. Its simplest action is to close the mouth by bringing the lips together. The upper or lower labial fibres may act separately, as well as those at the commissures of the lips, by which they are enabled in turn, to antagonise the different muscles which are attached around. By a very strong contraction of the labial and commissural fibres, the lips are thrown forwards in a circular projection, as in whistling. By the contraction of the inner labial fibres, they are drawn inwards upon the teeth.—

Muscles of the Lower Jaw.

The lower jaw has four pair of muscles for its elevation or lateral motions, namely, two, which are seen on the side of the face, and two concealed by the angle of the jaw.

1. *Temporalis,*

Arises, fleshy, from a semicircular ridge of the lower and lateral part of the parietal bone, from all the pars squamosa of the temporal bone, from the external angular process of the os frontis, from the temporal process of the sphenoid bone, and from an aponeurosis which covers it; from these different origins the fibres descend like radii towards the jugum, under which they pass; and are,

Inserted, by a strong tendon, into the upper part of the coronoid process of the lower jaw; in the duplicature of which ten-

don this process is enclosed as in a sheath, being continued down all its forepart to near the last dens molaris.

Use. To pull the lower jaw upwards, and press it against the upper, at the same time drawing it a little backwards.

N. B. This muscle is covered with a tendinous membrane, called its *aponeurosis,* which arises from the bones that give origin to the upper and semicircular part of the muscle; and descending over it, is inserted into all the jugum, and the adjoining part of the os frontis.

The use of this membrane is to give room for the origin of a greater number of fleshy fibres, to fortify the muscle in its action, and to serve as a defence to it.

2. *Masseter,*

Arises, by strong, tendinous, and fleshy fibres, which run in different directions, from the superior maxillary bone, where it joins the os malæ, and from the inferior and anterior part of the zygoma, *its whole length,* the external fibres slanting backwards, and the internal forwards.

Inserted into the angle of the lower jaw, and from that upwards to near the top of its coronoid process.

Use. To pull the lower to the upper jaw, and by means of its oblique decussation, a little forwards and backwards.

3. *Pterygoideus Internus,*

Arises, tendinous and fleshy, from the inner and upper part of the internal plate of the pterygoid process, filling all the space between the two plates; and from the pterygoid process of the os palati between these plates.

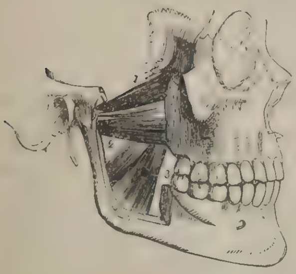
Inserted into the angle of the lower jaw internally.

Use. To draw the jaw upwards, and obliquely towards the opposite side.

4. *Pterygoideus Externus,*

Arises from the outer side of the external plate of the pterygoid process of the sphenoid bone, from part of the tuberosity of the os maxillare adjoining to it, and from the root of the temporal process of the sphenoid bone.

Fig. 78.*



Inserted into the cavity in the neck of the condyloid process of the lower jaw; some of its fibres are inserted into the ligament that connects the movable cartilage and that process to each other.

Use. To pull the lower jaw forwards, and to the opposite side; and to pull the ligament from the joint, that it may not be pinched during these motions: when both external pterygoid muscles act, the fore teeth of the under jaw are pushed forwards beyond those of the upper jaw.

The Muscles which appear about the anterior part of the Neck.

On the side of the neck are two muscles, or layers.

1. *Musculus Cutaneus,* vulgo *Platysma Myoides, (see fig.* 74,*)*

Arises, by a number of slender separate fleshy fibres, from the cellular substance that covers the upper part of the deltoid and pectoral muscles; in their ascent they all unite to form a thin muscle, which runs obliquely upwards along the side of the neck, adhering to the skin.

Inserted into the lower jaw, between its angle and the origin of the depressor anguli oris, to which it is firmly connected, and but slightly to the skin that covers the inferior part of the masseter muscle and parotid glands.

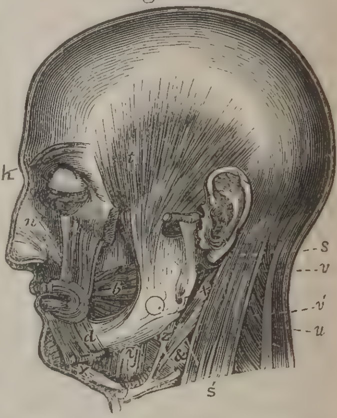
Use. To assist the depressor anguli oris, in drawing the skin of the cheek downwards; and when the mouth is shut, it draws all that part of the skin, to which it is connected, below the lower jaw, upwards.—Some of its fibres are inserted into the angle of the mouth, and are connected with the muscles of

* The two pterygoid muscles. The zygomatic arch and the greater part of the ramus of the lower jaw have been removed in order to bring these muscles into view. 1. The sphenoid origin of the external pterygoid muscle. 2. Its pterygoid origin. 3. The internal pterygoid muscle.

that region. They draw the corner of the mouth downwards, and constitute the musculus risorius of Santorini.—

2. *Sterno-cleido-mastoideus, (see fig. 76.)*

Fig 79.*



Arises by two distinct origins: the anterior tendinous and a little fleshy, from the top of the sternum near its junction with the clavicle; the posterior, fleshy, from the upper and anterior part of the clavicle; both unite a little above the anterior articulation of the clavicle, to form one muscle, which runs obliquely upwards and outwards, to be

Inserted, by a thick strong tendon, into the mastoid process, which it surrounds; and, gradually turning thinner, is inserted as far back as the lambdoid suture.

Use. To turn the head to one side, and bend it forwards.

Muscles situated between the Lower Jaw and Os Hyoides.

There are four layers before, and two muscles at the side.

The four layers are,

1. *Digastricus, (see fig. 79,)*

Arises, by a fleshy belly, intermixed with tendinous fibres, from the fossa at the root of the mastoid process of the temporal bone, and soon becomes tendinous; runs downwards and forwards: the tendon passes generally through the stylo-hyoideus muscle; then it is fixed by a ligament to the os hyoides; and, having received from that bone an addition of tendinous and muscular fibres, runs obliquely forwards, turns fleshy again, and is

* Fig. 79.—*b*, Buccinator. *d*, Depressor labii inferioris. *h*, Corrugator Supercilii. *n*, Compressor naris. *s*, Sterno-cleido-mastoid. *t*, Temporal. *u*, Trapezius. *v*, Splenius capitis. *v*, Splenius colli. *x*, Digastricus. *y*, Mylo-hyoid. *z*, Stylo hyoid. &, Hyo-glossus.

Inserted, by its anterior belly, into a rough sinuosity at the inferior and anterior edge of that part of the lower jaw called the *chin.*

Use. To open the mouth by pulling the lower jaw downwards, and backwards; and when the jaws are shut, to raise the os hyoides, and, consequently, the pharynx, upwards, as in deglutition.

2. *Mylo-Hyoideus, (See fig. 77,)*

Arises, fleshy, from all the inside of the lower jaw, between, the last dens molaris and the middle of the chin, where it joins with its fellow.

Inserted into the lower edge of the basis of the os hyoides, and joins with its fellow.

Use. To pull the os hyoides forwards, upwards, and to one side.

3. *Genio-Hyoideus,*

Arises, tendinous, from a rough protuberance in the middle of the lower jaw internally, or on the inside of the chin.

Inserted into the basis of the os hyoides.

Use. To draw this bone forwards to the chin.

4. *Genio-Hyo-Glossus.*

Arises, tendinous, from a rough protuberance in the inside of the middle of the lower jaw; its fibres run like a fan, forwards, upwards, and backwards; and are

Inserted into the whole length of the tongue, and base of the os hyoides, near its cornu.

Use. According to the direction of its fibres, to draw the tip of the tongue backwards into the mouth, the middle downwards, and to render its dorsum concave; to draw its root and os hyoides forwards, and to thrust the tongue out of the mouth.

The two muscles at the side are,

1. *Hyo-Glossus,*

Arises, broad and fleshy, from the base, cornu, and appendix, of the os hyoides; the fibres run upwards and outwards; to be

Inserted into the side of the tongue, near the stylo-glossus.

Use. To pull the tongue inwards and downwards.

2. *Lingualis,*

Arises from the root of the tongue laterally; runs forwards between the hyo-glossus and genio-glossus, to be

Inserted into the tip of the tongue, along with part of the stylo-glossus.

Use. To contract the substance of the tongue, and bring it backwards, and to elevate the point of the tongue.

Muscles situated between the Os Hyoides and Trunk.

These may be divided into two layers.

The first layer consists of two muscles,

1. *Sterno-Hyoideus,*

Arises, thin and fleshy, from the cartilaginous extremity of the first rib, the upper and inner part of the sternum, and from the clavicle where it joins with the sternum.

Inserted into the base of the os hyoides.

Use. To pull the os hyoides downwards.

2. *Omo-Hyoideus,*

Arises, broad, thin, and fleshy, from the superior costa of the scapula, near the semilunar notch, and from the ligament that runs across it; thence ascending obliquely, it becomes tendinous below the sterno-cleido-mastoid muscle; and, growing fleshy again, is

Inserted into the base of the os hyoides, between its cornu and the insertion of the sterno-hyoideus.

Use. To pull the os hyoides obliquely downwards.

The second layer consists of three muscles.

1. *Sterno-Thyroideus,*

Arises, fleshy, from the whole edge of the uppermost bone of the sternum internally, opposite to the cartilage of the first rib, from which it receives a small part of its origin.

Inserted into the surface of the rough line at the external part of the inferior edge of the thyroid cartilage.

Use. To draw the larynx downwards.

2. *Thyro-Hyoideus,*

Arises from the rough line opposite to the insertion of the former muscle.

Inserted into part of the basis, and almost all the cornu of the os hyoides.

Use. To pull the os hyoides downwards, or the thyroid cartilage upwards.

3. *Crico-Thyroideus,*

Which will be described with the larynx: Chap. xiv.

Muscles situated between the Lower Jaw and Os Hyoides laterally.

They are five in number. They proceed three from the styloid process of the temporal bone, from which they have half of their names; and two from the pterygoid process of the sphenoid bone.

The three from the styloid process are,

1. *Stylo-Glossus,*

Arises, tendinous and fleshy, from the styloid process, and from a ligament that connects that process to the angle of the lower jaw.

Inserted into the root of the tongue, runs along its side, and is insensibly lost near its apex.

Use. To draw the tongue laterally and backwards.

2. *Stylo-Hyoideus,*

Arises, by a round tendon, from the middle and inferior part of the styloid process.

Inserted into the os hyoides at the junction of the base and cornu.

Use. To pull the os hyoides to one side, and a little upwards.

N. B. Its fleshy belly is generally perforated by the tendon of the digastric muscle, on one or both sides. There is often another accompanying it, called *stylo-hyoideus alter;* and has the same origin, insertion, and use.

3. *Stylo-Pharyngeus,*

Arises, fleshy, from the root of the styloid process.

Inserted into the side of the pharynx and back part of the thyroid cartilage.

Use. To dilate the pharynx and raise it and the thyroid cartilage upwards.

The two from the pterygoid process are,

1. *Circumflexus, or Tensor Palati,*

Arises from the spinous process of the sphenoid bone, behind the foramen ovale, which transmits the third branch of the fifth pair of nerves, from the Eustachian tube, not far from its osseous part; it then runs down along the pterygoideus internus, passes over the hook of the internal plate of the pterygoid process by a round tendon, which soon spreads into a broad membrane.

Inserted into the velum pendulum palati, and the semilunar edge of the os palati, and extends as far as the suture which joins the two bones. Generally some of its posterior fibres join with the constrictor pharyngis superior, and palato-pharyngeus.

Use. To stretch the velum, to draw it downwards, and to one side towards the hook. It has little effect upon the tube, being chiefly connected to its osseous part.

2. *Levator Palati,*

Arises, tendinous and fleshy, from the extremity of the pars petrosa of the temporal bone, where it is perforated by the Eustachian tube, and also from the membranous part of the same tube.

Inserted into the whole length of the velum pendulum palati, as far as the root of the uvula, and unites with its fellow.

Use. To draw the velum upwards and backwards, so as to shut the passage from the fauces into the mouth and nose.

Muscles situated about the passage of the Fauces.

There are two on each side, and a single one in the middle. The two on each side are,

1. *Constrictor Isthmi Faucium,*

Arises, by a slender beginning, from the side of the tongue, near its root; thence running upwards within the anterior arch, before the amygdala, it is

Inserted into the middle of the velum pendulum palati, at the root of the uvula anteriorly, being connected with its fellow, and with the beginning of the palato-pharyngeus.

Use. Draws the velum towards the root of the tongue, which it raises at the same time, and with its fellow, contracts the passage between the two arches, by which it shuts the opening into the fauces.

2. *Palato-Pharyngeus,*

Arises, by a broad beginning, from the middle of the velum palati, at the root of the uvula posteriorly, and from the tendinous expansion of the circumflexus palati. The fibres are collected within the posterior arch behind the amygdala, and run backwards to the top and lateral part of the pharynx, where the fibres are scattered, and mix with those of the stylo-pharyngeus.

Inserted into the edge of the upper and back part of the thyroid cartilage; some of the fibres being lost between the membrane of the pharynx, and the two inferior constrictors.

Use. Draws the uvula and velum downwards and backwards; and, at the same time, pulls the thyroid cartilage and pharynx upwards, and shortens it; with the constrictor superior and tongue, it assists in shutting the passage into the nostrils; and, in swallowing, it thrusts the food from the fauces into the pharynx.

Salpingo-Pharyngenus, (from ςαλπιλξ, trumpet,)

Of Albinus, is composed of a few fibres of this muscle, which

Arise from the anterior and lower part of the cartilaginous extremity of the Eustachian tube ; and are,

Inserted into the inner part of the last-mentioned muscles.

Use. To assist the former, and to dilate the mouth of the tube.

The one in the middle is the

Azygos Uvulæ,

Arises, fleshy, from the extremity of the suture which joins the palate bones, runs down the whole length of the velum and uvula, resembling a small earth-worm, and adhering to the tendons of the circumflexi. Two are frequently met with.

Inserted into the apex of the uvula.

Use. Raises the uvula upwards and forwards, and shortens it.

Muscles situated on the posterior part of the Pharynx.

Of these there are three pair :

1. *Constrictor Paryngis Inferior,*

Arises, from the side of the thyroid cartilage, near the attachment of the thyroideus and thyro-hyoideus muscles ; and from the cricoid cartilage, near the crieo-thyroideus. This muscle is the largest of the three ; and is

Inserted into the white line, where it joins with its fellow ; the superior fibres running obliquely upwards, covering nearly one half of the middle constrictor, and terminating in a point ; the inferior fibres run more transversely and covers the beginning of the œsophagus.

Use. To compress that part of the pharynx which it covers, and to raise it with the larynx a little upwards.

2. *Constrictor Pharyngis Medius,*

Arises from the appendix of the os hyoides, from the cornu of that bone, and from the ligament which connects it to the thyroid cartilage ; the fibres of the superior part running

obliquely upwards, and, covering a considerable part of the superior constrictor, terminate in a point.

Inserted into the middle of the cuneiforme process of the os occipitis, before the foramen magnum, and joined to its fellow at a white line in the middle back part of the pharynx. The fibres at the middle part run more transversely than those above or below.

Use. To compress that part of the pharynx which it covers, and to draw it and the os hyoides upwards.

3. *Constrictor Pharyngis Superior,*

Arises, above, from the cuneiforme process of the os occipitis, before the foramen magnum, near the holes where the ninth pair of the nerves passes out; lower down, from the pterygoid process of the sphenoid bone; from the upper and under jaw, near the roots of the last dentes molares; and between the jaws, it is continued with the buccinator muscle; and with some fibres from the root of the tongue, and from the palate.

Inserted into a white line in the middle of the pharynx, where it joins with its fellow, and is covered by the constrictor medius.

Use. To compress the upper part of the pharynx, and draw it forwards and upwards. See article, pharynx.

Muscles situated about the Glottis.

They consist generally of four pair of small muscles, and a single one. See Larynx, chapt. xiv.

Muscles situated on the Anterior Part of the Neck, close to the Vertebræ. (Prævertebral Muscles.)

These consist of one layer, formed by four muscles.

1. *Longus Colli,*

Arises, tendinous and fleshy from the bodies of the three vertebræ of the back laterally; and from the transverse process of the third, fourth, fifth, and sixth vertebræ of the neck, near their roots.

Inserted into the forepart of the bodies of all the vertebræ of the neck, by as many small tendons, which are covered with flesh.

Use. To bend the neck gradually forwards, and to one side.

2. *Rectus Capitis Internus Major,*

Arises from the anterior points of the transverse process of the third, fourth, fifth, and sixth vertebræ of the neck, by four distinct beginnings.

Inserted into the cuneiforme process of the os occipitis, a little before the condyloid process.

Use. To bend the head forwards.

3. *Rectus Capitis Internus Minor,*

Arises, fleshy, from the forepart of the body of the first vertebra of the neck opposite to the superior oblique process.

Inserted near the root of the condyloid process of the os occipitis, under, and a little farther outwards, than the former muscle.

Use. To bend the head forwards.

4. *Rectus Capitis Lateralis,*

Arises, fleshy, from the anterior part of the point of the transverse process of the first vertebra of the neck.

Inserted into the os occipitis, opposite to the foramen stylo-mastoideum of the temporal bone.

Use. To bend the head a little to one side.

Fig. 80.*

* The prævertebral group of muscles of the neck. 1. The rectus anticus major muscle. 2. The scalenus anticus. 3. The lower part of the longus colli of the right side; it is concealed superiorly by the rectus anticus major. 4. The rectus anticus minor. 5. The upper portion of the longus colli muscle. 6. Its lower portion; the figure rests upon the seventh cervical vertebra. 7. The scalenus posticus. 8. The rectus lateralis of the left side. 9. One of the intertransversales muscles.

Muscles situated on the Anterior Part of the Thorax.

These may be divided into two layers. The first layer consists of one muscle, named

Pectoralis Major,

Arises from the cartilaginous extremities of the fifth and sixth ribs, where it always intermixes with the external oblique muscle of the abdomen; from almost the whole length of the sternum: and from near half of the anterior part of the clavicle; the fibres run towards the axilla in a folding manner.

Inserted, by two broad tendons, which cross each other at the upper and inner part of the os humeri, above the insertion of the deltoid muscle, and outer side of the groove for lodging the tendon of the long head of the biceps.

Use. To move the arm forwards, and obliquely upwards, towards the sternum.

The second layer consists of three muscles.

1. *Subclavius,*

Arises, tendinous, from the cartilage that joins the first rib to the sternum.

Inserted, after becoming fleshy, into the inferior part of the clavicle, which it occupies from within an inch of the sternum, as far outwards as to its connexion, by ligament, with the coracoid process of the scapula.

Use. To pull the clavicle downwards and forwards.

2. *Pectoralis Minor,*

Arises, tendinous and fleshy, from the upper edge of the third, fourth, and fifth ribs, near where they join with their cartilages.

Inserted, tendinous, into the coracoid process of the scapula: but soon grows fleshy and broad.

Use. To bring the scapula forwards and downwards, or to raise the ribs upwards.

3. *Serratus Magnus,*

Arises from the nine superior ribs, by an equal number of fleshy digitations, resembling the teeth of a saw.

Inserted, fleshy, into the whole base of the scapula internally, between the insertion of the rhomboid and the origin of the subscapularis muscle, being folded about the two angles of the scapula.

Use. To move the scapula forwards: and, when the scapula is forcibly raised, to draw upwards the ribs.

Muscles situated between the Ribs, and within the Thorax.

Between the ribs, on each side, there are eleven double rows of muscles, which are, therefore, named *intercostals.* These decussate each other like the strokes of the letter X.

1. *Intercostales Externi,*

Arise from the inferior acute edge of each superior rib, and run obliquely forwards, the whole length from the spine to near the joining of the ribs with their cartilages; from which, to the sternum, there is only a thin membrane covering the internal intercostals.

Inserted into the upper obtuse edge of each inferior rib, as far back as the spine, into which the posterior portion is fixed.

2. *Intercostales Interni,*

Arise in the same manner as the external: but they begin at the sternum, and run obliquely backwards, as far as the angle of the rib; and from that to the spine they are wanting.

Inserted in the same manner, as the external.

Use. By means of these muscles, the ribs are equally raised upwards, during inspiration. Their fibres being oblique, give them a greater power of bringing the ribs near each other, than could be performed by straight ones. By the obliquity of the fibres, they are almost brought contiguous: and as the fixed points of the ribs are before and behind, if the external had been continued forwards to the sternum, and the internal

backwards to the spine, it would have hindered their motion, which is greatest in the middle, though the obliquity of the ribs renders it less perceptible ; and, instead of raising the fibres fixed to the sternum and spine, would have depressed the ribs.

N. B. The portions of the external intercostals, which arise from the transverse processes of the vertebræ where the ribs are fixed to them, and other portions that pass over one rib and terminate in the next below it, Albinus calls *Levatores costarum longiores et breviores.*

The portions of the internal that pass over one rib, and are inserted into the next below it, are, by Douglas, called *Costarum depressores proprii Cowperi.*

These portions of both rows assist in raising the ribs in the same manner as the rest of the intercostals.

The muscles within the thorax form one pair, viz.

Triangularis, or Sterno-Costalis,

Arises, fleshy, and a little tendinous, from all the length of the cartilago-ensiformis laterally, and from the edge of the lower half of the middle bone of the sternum, from whence its fibres ascend obliquely upwards and outwards.

Inserted, generally by three triangular terminations, into the lower edge of the cartilages of the third, fourth, and fifth ribs ; near where these join with the ribs.

Use. To depress these cartilages, and the extremities of the ribs; and consequently to assist in contracting the cavity of the thorax.

This muscle often varies; and is sometimes inserted into the cartilage of the second rib, sometimes into the cartilages of the sixth rib.

Muscles situated on the anterior part of the Abdomen.

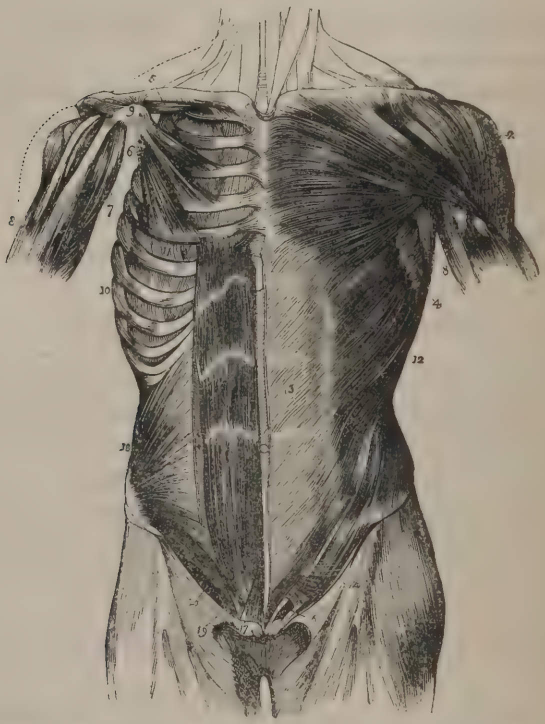
They consist of three broad layers on each side of the belly and, of one layer in front.

The three layers are :

1. *Obliquus Descendens Externus,*

Arises, by eight heads, from the lower edges of an equal number of the inferior ribs, at a little distance from their cartilages: it always intermixes in a serrated manner, with portions of the

Fig. 81.*



* The muscles of the anterior aspect of the trunk; on the left side the superficial layer is seen, and on the right the deeper layer. 1. The pectoralis major muscle. 2. The deltoid; the interval between these muscles lodges the cephalic vein. 3. The anterior border of the latissimus dorsi. 4. The serrations of the serratus magnus. 5. The subclavius muscle of the right side. 6. The pectoralis minor. 7. The coraco-brachialis muscle. 8. The upper part of the biceps muscle, showing its two heads. 9. The coracoid process of the scapula. 10. The serratus magnus of the right side. 11. The external intercostal muscle of the fifth intercostal space. 12. The external oblique muscle. 13. Its aponeurosis; the median line to the right of this number is the linea alba; the flexuous line to its left is the linea semilunaris; and the transverse lines above and below the number, the lineæ transversæ, of which there were only

serratus major anticus; and generally coheres to the pectoralis major, intercostals, and latissimus dorsi; which last covers the edge of a portion of it extended from the last rib to the spine of the ilium. —It interdigitates by its five upper heads with the serratus major anticus, and by the three lower with the latissimus dorsi, where the latter arises from the ribs; a slip from the pectoralis covers the first or upper head.—

From these origins the fibres run obliquely downwards and forwards, and terminate in the anterior half of the spine of the ilium, and in a tendinous membrane, whose fibres are continued in the same direction until they meet the fibres of the corresponding tendon of the other side, in a line which extends from the ensiform cartilage to the symphysis pubis.

This line is called linea alba, from its white appearance, which is owing to the connexion of three tendons with each other, without the intervention of muscles, namely, those of the external and internal oblique, and the transversalis.*

On each side of the line, two long narrow muscles, *(the recti,)* are situated between these tendons, and do away the white appearance; but exterior to these muscles, the tendons

three in this subject. 14. Poupart's ligament. 15. The external abdominal ring; the margin above the ring is the superior or internal pillar; the margin below the ring, the inferior or external pillar; the curved intercolumnar fibres are seen proceeding upwards from Poupart's ligament to strengthen the ring. The numbers 14 and 15 are situated upon the fascia lata of the thigh; the opening immediately to the right of 15 is the opening for the saphena vein. 16. The rectus muscle of the right side brought into view by the removal of the anterior segment of its sheath: * the posterior segment of its sheath with the divided edge of the anterior segment. 17. The pyramidalis muscle. 18. The internal oblique muscle. 19. The conjoined tendon of the internal oblique and transversalis descending behind Poupart's ligament to the pectineal line. 20. The arch formed between the lower curved border of the internal oblique muscle and Poupart's ligament; it is beneath this arch that the spermatic ord and hernia pass.

* According to Meckel, the linea alba performs the same office in the abdomen as the sternum does in the thorax, with this only difference, that it is not formed of bone. The anterior tendons of the broad muscles are attached to it, in the same way that the cartilages of the ribs are articulated with the sternum, and the difference of tissue which exists between it and the sternum is attributable to the general difference of structure between the abdominal and pectoral cavities, the latter being formed almost entirely of osseous parts, whilst the walls of the former are fleshy and tendinous.—P.

are again united, and form a white line on each side, which is called linea semilunaris, from its curved shape.

At the lower part of the tendon, near the os pubis, the fibres are so arranged, that they form two bands more firm and dense than the rest of the tendon, which are called columns: these columns are separated from each other; and the vacuity between them is the abdominal ring, or aperture, for the passage of the spermatic chord in males and the round ligament of the uterus in females. This vacuity or aperture has an oval form, which is occasioned by some additional tendinous fibres at the upper part of it, that have a transverse direction.

The uppermost of the two columns is continued obliquely downwards, and is inserted into the os pubis of the opposite side, near the symphysis, decussating the fibres of the corresponding column of that side.

The lower edge of the tendon of the external oblique is attached to the superior anterior spinous process of the ilium, and is there blended with the tendinous fascia, which extends down the thigh.

From this process the edge of the tendon is extended, like the chord of a bow, across the concavity formed by the os ilium and os pubis, and is inserted into the pubis near its symphysis. As it proceeds from the spine of the ilium towards the pubis, the edge is folded inwards, so that the membrane is doubled. The portion which is turned inwards, *(Gimbernat's ligament,)* is very small at its commencement, and continues so for a great part of its extent; but becomes much broader within an inch of its termination. This broad extremity is inserted into the small process of the pubis near the symphysis, and into a ridge which continues backward from the process to the brim of the pelvis, so that the tendinous membrane at this part is doubled; the part which is turned back being about an inch broad at the place of its insertion into the pubis.

This doubling forms a partial sheath near the pubis for containing the spermatic chord, and supports it for a short distance on the inside of the abdominal ring.

The edge formed by the fold of the membrane is called *Poupart's* ligament, and is very firm and strong; owing to the membrane being thicker at that place. The real edge, or termination of the portion which is folded inwards, is arranged in the following manner: the part which is nearest to the spine of the ilium is continued into the cellular membrane, or the fascia, which is between the internal oblique and transversalis muscles, and the iliacus internus.

But the edge of that part of Poupart's ligament which is inserted into the ridge of the pubis seems to form a portion of an oval opening, which is occupied in part, but not completely, by the crural vessels.

—The femoral artery is found at the outer margin of this oval opening, see fig. 81. The femoral vein is placed on the inner side of the artery; on the inner side of the vein again is left a roundish opening, the proper crural ring, occupied only by some loose fat, lymphatic vessels and a small gland, through which the viscera protrude in crural hernia.—

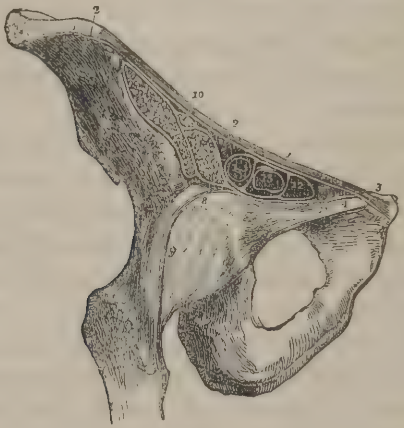
—This edge of Poupart's ligament, inserted into the ridge or crest of the pubis is of a triangular shape, and is called *Gimbernat's ligament.* It is one of the seats of stricture in crural hernia. The base of the triangle is towards the symphysis pubis.—

A portion of the fascia lata of the thigh, which covers these vessels, passes under this portion of the tendon, and is also inserted into the ridge of the pubis; so that when the intestines protrude at this aperture, and are strangulated, this portion of the fascia of the thigh must also compress them. —This portion of the fascia lata femoris, is called the crescentic or falciform portion of the fascia lata. The sharp edge at its inner part, by which it is nearly continuous with Gimbernat's ligament, and which is directed downwards and backwards, is called Hey's ligament or the femoral ligament; it is directly above or in front of the crural ring—that space between the crural vein and Gimbernat's ligament, included in the sheath of the femoral vessels, and through which the viscera protrude in crural hernia.—

The fascia lata of the thigh is connected with the external or lower edge of Poupart's ligament, in its whole extent: this is called the sartorial portion.

—The fascia lata may here be considered as divided into two layers: 1st, The sartorial. 2nd, The pectineal which continuous above and without, as seen in fig. 28, is reflected behind

Fig. 82.*



the sheath of the vessels, and over the anterior surface of the pectineus muscle up to the spine of the pubis. The sheath of the femoral vessels is formed by an extension downwards of the fascia transversalis and fascia iliaca for about an inch and a half between these layers of the fascia lata.—And there is

* A section of the structures which pass beneath the femoral arch. 1. Poupart's ligament. 2, 2. The upper or sartorial portion of the fascia lata, attached along the margin of the crest of the ilium, and along Poupart's ligament, as far as the spine of the os pubis (3). 4. The pubic or pectineal portion of the fascia lata, continuous at 3 with the iliac portion, and passing outwards behind the sheath of the femoral vessels to its outer border at 5, where it divides into two layers; one is continuous with the sheath of the psoas (6) and iliacus (7); the other (8) is lost upon the capsule of the hip-joint (9). 10. The femoral nerve, enclosed in the sheath of the psoas and iliacus. 11. Gimbernat's ligament. 12. The femoral ring, within the femoral sheath. 13. The femoral vein. 14. The femoral artery: the two vessels and the ring are surrounded by the femoral sheath, and thin septa are sent between the anterior and posterior wall of the sheath, dividing the artery from the vein, and the vein from the femoral ring.

also a fascia *(fascia superficialis abdominis)* which covers the whole tendon of the external oblique muscle, and passes from it down upon the fascia of the thigh: which also connects the tendon of the external oblique to the fascia of the thigh, and serves to bind it down. From these connexions it is probable that the tendon is in a very different situation before dissection, from what it is afterwards; as the division of these connexions, necessarily made by the dissection, renders it much more loose than it could have been while the parts were undivided. This structure has latterly been called the crural arch. The fascia which covers the tendon of the external oblique muscle, and descends upon the thigh, can be examined very easily in anasarcous subjects; as in them, the cellular membrane, which is situated between this fascia and the tendon, is somewhat distended by the effused fluid.

To prepare Poupart's ligament or the crural arch, for examination, remove carefully the cellular membrane from the tendon of the external oblique, and also from the fascia of the thigh, taking care not to remove any part of the fascia which passes under the tendon to be inserted into the os pubis. Then make an incision in the tendon of the external oblique, about three inches above Poupart's ligament, parallel to it, and nearly of the same length; make a second incision from the upper end of this, to the junction of the aforesaid ligament with the superior anterior spine of the ilium; and a third incision from the lower end to the abdominal ring. Dissect this flap carefully from the internal oblique, until the spermatic chord, the cremaster muscle, and the lower origin of the internal oblique, are perfectly uncovered. After examining the internal surface of the tendon and its insertion at the pubis, the fascia of the thigh may be dissected, so that its connexion with the folded edge of the tendon, and its insertion into the pubis, may also be examined.

The external oblique muscles compress the abdomen, and therefore contribute to the evacuation of its contents: if the diaphragm is in a passive state, they force it upwards, by pressing the abdominal viscera against it; and thus assist in

producing expiration and its various modifications of coughing, sneezing, &c.

They bend the spine forwards, or approach the thorax to the pelvis.

When one acts separately, it bends the trunk obliquely to the side on which it is situated.

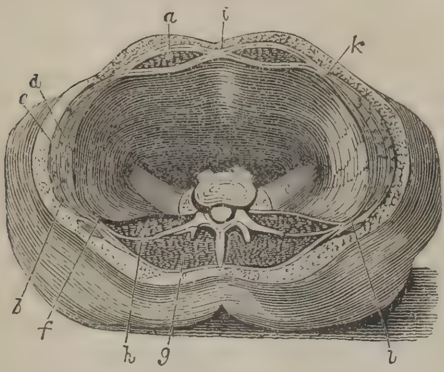
3. *Obliquus Ascendens Internus,*

Arises from the spine of the ilium the whole length between the posterior and superior anterior spinous process; from the os sacrum and the three undermost lumbar vertebræ, by a tendon, *(fascia lumborum)* common to it, to the serratus posticus inferior muscle, and to the latissimus dorsi; from Poupart's ligament, at the middle of which it sends off the beginning of the cremaster muscle; the spermatic chord in the male, or round ligament of the womb in the female, passes under its thin edge, with the exception of a few detached fibres.

Inserted into the cartilago-ensiformis, into the cartilages of the seventh, and those of the false ribs; but, at the upper part, it is extremely thin, resembling a cellular membrane, and only becomes fleshy at the cartilage of the tenth rib. Here its tendon divides into two layers; the anterior layer, with a great portion of the inferior part of the posterior layer, joins the tendon of the external oblique, and runs over the rectus to be inserted into the whole length of the linea alba. The posterior layer joins the tendon of the transversalis muscle as low as half way between the umbilicus and os pubis; but, below this place, only a few fibres of the posterior layer are seen, and the rest of it passes before the rectus muscle, and is inserted into the linea alba; so that the whole tendon of the external oblique muscle, with the anterior layer of the internal oblique, passes before the rectus muscle; and the whole posterior layer of the internal oblique, together with the whole tendon of the transversalis muscle, excepting at the inferior part, passes behind the rectus, and is inserted into the linea alba. At its undermost part, it is inserted into the forepart of the os pubis.

Use. To assist the former; but it bends the trunk in the reverse direction.

Fig. 83.*



3. *Transversalis,*

Arises, tendinous, but soon becoming fleshy, from the inner or back part of the cartilages of the seven lower ribs, where some of its fibres are continued with those of the diaphragm and the intercostal muscles; by a broad thin tendon, connected to the transverse processes of the last vertebra of the back, and the four superior vertebræ of the loins; fleshy, from the whole spine of the os ilium internally, and from the tendon of the external oblique muscle where it intermixes with some fibres of the internal oblique.

Inserted into the cartilago-ensiformis, and into the whole length of the linea alba, excepting its lowermost part.

Use. To support and compress the abdominal viscera, and

* *Transverse section of abdomen.—a,* Division of the tendon of the internal oblique into two layers, forming a sheath in which is contained the rectus muscle. *b,* External oblique. *c,* Internal oblique. *d,* Transversalis. *e,* Between the last rib and the crista of the ilia, the fibres of the transversalis, arise from a tendinous layer, which is trifoliate in its origin, according to Todd. *f,* The anterior division, arising from the roots of the transverse processes, and covering the quadratus lumborum muscle. *h, g,* The middle, which is weak, attached to the apices of the transverse processes. The posterior is the fascia lumborum.

Fig. 84.*

it is so particularly well adapted for the latter purpose, that it might be called the *proper constrictor* of the abdomen.

The long muscle in the middle is named

Rectus Abdominis,

Arises, by two heads, from the ligament of the cartilage which joins the two ossa pubis to each other; runs upwards the whole length of, and parallel to the linea alba, growing broader and thinner as it ascends.

Inserted into the cartilages of the three inferior true ribs, and often intermixed with some fibres of the pectoral muscle.

It is generally divided by three tendinous intersections: the first is at the umbilicus; the second, where it runs over the cartilage of the seventh rib; and the third in the middle between these; and there is commonly a half intersection below the umbilicus. These intersections *(lineæ transversæ)* seldom penetrate through the whole thickness of the muscle: they adhere firmly to the

*A lateral view of the trunk of the body, showing its muscles, and particularly the transversalis abdominis. 1. The costal origin of the lattissimus dorsi muscle. 2. The serratus magnus. 3. The upper part of the external oblique muscle divided in the direction best calculated to show the muscles beneath without interfering with its indigitations with the serratus magnus. 4. Two of the external intercostal muscles. 5. Two of the internal intercostals. 6. The transversalis muscle. 7. Its posterior aponeurosis. 8. Its anterior aponeurosis forming the most posterior layer of the sheath of the rectus. 9. The lower part of the left rectus with the aponeurosis of the transversalis passing in front. 10. The right rectus muscle. 11. The arched opening left between the lower border of the transversalis muscle and Poupart's ligament, through which the spermatic cord and hernia pass. 12. The gluteus maximus, and medius, and tensor vaginæ femoris muscles invested by fascia lata.

anterior part of the sheath, but very slightly to the posterior layer.*

Use. To compress the forepart, but more particularly the lower part of the belly; to bend the trunk forwards, or to raise the pelvis. By its tendinous intersection, it is enabled to contract at any of the intermediate spaces; and, by its connexion with the tendons of the other muscles, it is prevented from changing place, and from rising into a prominent form when in action.

The short muscle in the middle is named

Pyramidalis,

Arises along with the rectus; and running upwards within the same sheath, is

Inserted, by an acute termination, near half way between the os pubis and umbilicus, into the linea alba and inner edge of the rectus muscle.

As it is frequently wanting in both sides without any inconvenience, its

Use seems to be, to assist the inferior part of the rectus.

Muscles about the male Organs of Generation.

The *testicles* are said to have a thin muscle common to both, and one proper to each.

The common muscle is called the

Dartos.

This consists of muscular fibres blended with the cellular membrane lining the scrotum; and therefore this portion of

* To obtain an accurate idea of the arrangement of the tendons of the three large pair of abdominal muscles, it will be necessary to raise or separate the external oblique muscle and tendon from the internal oblique and its tendon, as far as the linea semilunaris, and to separate the internal oblique in the same manner from the transversalis; and then to make an incision in the tendon of the external oblique parallel to the linea alba, and about an inch and a half from it, so as to bring the whole of the rectus muscle into view. The structure of the sheath which contains the rectus can then be examined.

skin is capable of being corrugated and relaxed in a greater degree than the skin in other places.

The muscle proper to each testicle is the

Cremaster.

Arises from the internal oblique, where a few fibres of that muscle intermix with the transversalis, near the juncture of the os ilium and pubis, over which part it passes, after having pierced the ring of the externus obliquus; and then it descends upon the spermatic chord.

Inserted into the tunica vaginalis of the testicle, upon which it spreads, and is insensibly lost.*

Use. To suspend and draw up the testicle, and to compress it in the act of coition.

The penis has three pairs of muscles:

1. *Erector Penis.*

Arises, tendinous and fleshy, from the tuberosity of the os ischium, and runs upwards, embracing the whole crus of the penis

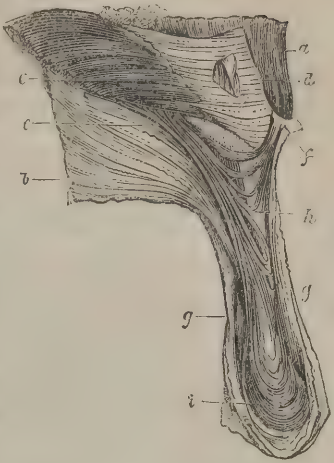
Inserted into the strong tendinous membrane that covers the corpus cavernosum penis, nearly as far as the union of these bodies.

Use. To compress the crura penis, by which the blood is

* M. J. Cloquet says, that the scattered fasciculi of this muscle are collected after their distribution on the tunica vaginalis, and run up on the inner side of the chord, to be inserted into the spine of the pubis. He makes the inference from this, that the cremaster is a kind of muscular loop, drawn down by the descent of the testicle. I am satisfied that the muscle in robust subjects, frequently exists, more or less, after the manner in which he speaks of it: but, in the emaciated, it is very indistinct, as regards such an insertion. In the cases where I have seen this insertion into the spine of the pubis, the quantity of muscular fibre has been by no means so great there as at its origin. This observation of M. Cloquet's is ingenious and interesting, but it is well worthy of consideration, that Mr. John Hunter's opinion, in his paper on the descent of the testicle, is opposed to it, and on the following grounds: in the young ram, and in several other animals, the cremaster muscle is formed before the testicle descends from the abdomen into the scrotum, being reflected along the gubernaculum testis upwards towards the loins. Mr. Hunter could not, it is true, verify the same observation on the human subject, but he is disposed, from analogy, to believe that something of the kind exists.—H.

pushed from it into the forepart of the corpora cavernosa; and the penis is by that means more completely distended. The erectores seem, likewise, to keep the penis in its proper direction.

Fig. 85.*



2. *Accelerator Urinæ* seu *Ejaculator Seminis.*

Arises, fleshy, from the sphincter ani and membranous part of the urethra; and tendinous, from the crus, nearly as far forwards as the beginning of the corpus cavernosum penis: the inferior fibres run more transversely; and the superior descend in an oblique direction.

Inserted into a line in the middle of the bulb where it joins with its fellow, by which the bulb is completely enclosed.

Use. To drive the urine or semen forwards; and, by grasping the bulb of the urethra, to push the blood towards the corpus cavernosum and the glans, by which these parts are distended.

3. *Transversus Perinei,*

Arises from the tough fatty membrane that covers the tuberosity of the os ischium; from thence it runs transversely inwards, and is

Inserted into the accelerator urinæ, and into that part of the

* Cremaster, from Sir A. Cooper's work. *a*, Rectus muscle. *b*, Descending portion of the fascia superficialis. *c*, The internal oblique. *d*, Conjoined tendons. *e*, The descending fibres of oblique. *f*, Point of insertion into the pubis. *g*, Ascending fibres. *h*, One of the reversed arches.

The formation of the cremaster, appears to be effected by the testicle in its descent, (as Scarpa, Cloquet, Cooper, Velpeau, and Todd admit,) for before that takes place, the muscle does not exist, according to Cloquet. Prior to the descent, the *gubernaculum testis* occupies the inguinal canal, and is covered by the fibres of the internal oblique, which adhere to it. When the testis is drawn down by the gubernaculum, these fibres descend with it, forming a series of reversed arches.

sphincter ani which covers the bulb. The place of junction of these muscles is called the perineal point or centre.

Use. To dilate the bulb, and draw the perineum and verge of the anus a little outwards and backwards.

There is often a fourth muscle, named

Transversus Perinei Alter,

Arises behind the former, runs more obliquely forwards, and is

Inserted into that part of the accelerator urinæ which covers the anterior part of the bulb of the urethra.

Use. To assist the former.

In the Medico-Chirurgical Transactions, James Wilson, Esq. F. R. S. gives the following account of two small muscles of the membranous part of the urethra, viz: Each muscle has a tendon which, at first, is round, but soon becomes flattened as it descends. It is affixed to the back part of the symphysis pubis, about one-eighth of an inch above the lower edge of the cartilaginous arch of the pubes, and nearly at the same distance, below the attachment of the tendon of the bladder: to which, and to the tendon of the corresponding muscle, it is connected by very loose cellular membrane. The tendon descends at first in contact with, and parallel to, its fellow: it soon becomes broader, and sends off fleshy fibres, which also increase in breadth, and, when near the upper surface of the membranous part of the urethra, separate from those of the opposite side, spread themselves on the side of the membranous part of the urethra through its whole extent; then fold themselves under it, and meet in a middle tendinous line with similar fibres of the opposite side.

Its action seems to be to draw up the membranous part of the urethra, and compress it against the inside of the cartilaginous arch of the pubes; and also to contract the circle round the membranous portion, so as to diminish and even close up the passage of the urine.* It is known under the name of the muscle of Wilson.

Muscles of the Anus.

The *anus* has a single muscle, and one pair.

The single muscle is

Sphincter Ani.

Arises from the skin and fat that surrounds the verge of the

* I have frequently dissected for this muscle, and in only two or three cases have been able to satisfy myself of its having an existence distinct from that of the Levator Ani. My friend, Mr. Shaw, who occupies a distinguished rank among the cultivators of anatomy in London, admits of this muscle, but says there is much difficulty in distinguishing it from the ligament of the urethra, meaning, I presume, its triangular ligament.—H.

anus on both sides, nearly as far as the tuber of the os ischium; the fibres are gradually collected into an oval form, and surround the extremity of the rectum.

Fig. 86.*

Inserted, before, by a narrow point, into the perineum, acceleratores urinæ, and transversi perinei; behind, by an acute termination, into the extremity of the os coccygis.

Use. Shuts the passage through the anus into the rectum; pulls down the bulb of the urethra, by which it assists in ejecting the urine and semen. —The sphincter ani is always in a contracted state, except at the time of the evacuation of the fœces. When the sphincter is in a healthy state, it may be made by an effort of the will to contract more strongly, but it cannot be made to relax.

—The irritation induced by the accumulation of fæces in the rectum, causes it at first to contract more strongly, and the contraction continues till it is overcome, by the increasing

* The muscles of the perineum. 1. The acceleratores urinæ muscles; the figure rests upon the corpus spongiosum penis. 2. The corpus cavernosum of one side. 3. The erector penis of one side. 4. The transversus perinei of one side. 5. The triangular space through which the deep perineal fascia is seen. 6. The sphincter ani; its anterior extremity is cut off. 7. The levator ani of the left side; the deep space between the tuberosity of the ischium (8) and the anus, is the ischio-rectal fossa; the same fossa is seen upon the opposite side. 9. The spine of the ischium. 10. The left coccygeus muscle. The boundaries of the perineum are well seen in this engraving.

effort of the muscular fibres of the rectum, and the action of the diaphragm and abdominal muscles. It acts also as an antagonist to the levator ani muscles.—

N. B. The sphincter internus of Albinus and Douglas, is only that part of the cellular fibres of the muscular coat of the rectum which surrounds its extremity.

Levator Ani,

Arises from the os pubis within the pelvis, as far up as the upper edge of the foramen thyroideum, and joining of the os pubis with the os ischium; from the thin tendinous membrane that covers the obturator internus and coccygeus muscle, and from the spinous process of the os ischium: its fibres run down like rays from a circumference to a centre.

Inserted into the sphincter ani, acceleratores urinæ, and anterior part of the two last bones of the os coccygis; surrounds the extremity of the rectum, neck of the bladder, prostate gland, and part of the vesicula seminalis; so that its fibres behind and below the os coccygis joining it with its fellow, they together very much resemble the shape of a funnel.

Use. To draw the rectum upwards after the evacuation of the fæces, and to assist in shutting it; to sustain the contents of the pelvis, and to help in ejecting the semen, urine, and contents of the rectum; and, perhaps by pressing upon the veins, to contribute greatly to the erection of the penis.

—The muscular funnel, formed by the levator ani muscles of the two sides is antagonised by the action of the sphincter ani, which, by its connexion with the coccyx and perineal centre prevents its lower extremity from being drawn upwards. —When the sphincter is inflamed, and a fluid effused among its fibres, as is an occasional occurrence in the bowel complaint of children, the sphincter loses its power, and the levator ani muscles, unopposed, retract; and thus by everting the lower margin of the rectum, contribute mainly to the formation of prolapsus ani.—

Muscles of the Female Organs of Generation.

The *clitoris* has one pair.

Erector Clitoridis,

Arises from the crus of the os ischium internally, and in its ascent covers the crus of the clitoris as far up as the os pubis.

Inserted into the upper part of the crus and body of the clitoris.

Use. Draws the clitoris downwards and backwards; and may serve to make the body of the clitoris more tense by squeezing the blood into it from its crus.

The vagina has one pair.

Sphincter Vaginæ,

Arises from the sphincter ani, and from the posterior side of the vagina, near the perineum; from thence it runs up the side of the vagina, near its external orifice, opposite to the nymphæ and covers the corpus cavernosum vaginæ.

Inserted into the crus and body or union of the crura clitoridis.

Use. Contracts the mouth of the vagina, and compresses its vascular plexus, called corpus cavernosum, or *rete mirabile.*

Transversus Perinei,

Arises, as in the male, from the fatty cellular membrane which covers the tuberosity of the os ischium.

Inserted into the upper part of the sphincter ani, and into a white hardish tough substance in the perineum, between the lower part of the pudendum and anus.

Use. To sustain and keep the perineum in its proper place.

The anus, as in the male, has a single muscle, and one pair.

Sphincter Ani.

Arises, as in the male, from the skin and fat surrounding the extremity of the rectum.

Inserted, above, in the white tough substance of the perineum *(perineal centre;)* and below, into the point of the os coccygis.

Use. To shut the passage into the rectum; and, by pulling

down the perineum, to assist in contracting the mouth of the vagina.

Levator Ani,

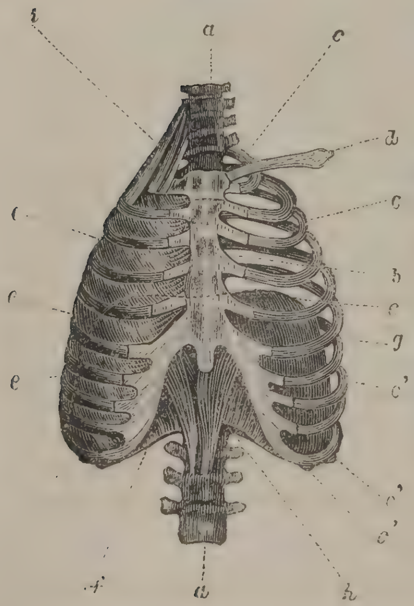
Arises, as in the male, within the pelvis, and descends along the inferior part of the vagina and rectum.

Inserted into the perineum, sphincter ani, extremity of the vagina and rectum.

Use. To raise the extremity of the rectum upwards, to contract the inferior part of the rectum, and to assist in contracting and supporting the vagina; and, perhaps, by pressing on the veins, to contribute to the distention of the cells of the clitoris and corpus cavernosum of the vagina.

Muscles situated within the Cavity of the Abdomen.

Fig. 87.*



These consist of a single muscle, and four pair.

Diaphragma.

This broad thin muscle, which makes a complete septum between the thorax and abdomen, is concave below and convex above; the middle of it on each side reaching as high within the thorax of the skeleton as the fourth rib: it is commonly divided into two portions.

1. The superior or,

Greater Muscle of the Diaphragm.

Arises, by distinct fleshy

* *Thorax of a male.*—On the left side the muscles are removed; on the right they are left *in situ*. *a, a*, Cervical and lumbar parts of the spinal column, the dorsal portion is concealed by the sternum, *b*. *c, c*, The true ribs. *c'*, The false ribs. *d*, The clavicle. *e*, Intercostal muscles. *f*, Last false rib, concealed by the origin of

fibres, from the cartilago-ensiformis, from the cartilages of the seventh, and of all the inferior ribs on both sides. The fibres from the cartilago-ensiformis, and from the seventh and eighth ribs, run obliquely upwards and backwards; from the ninth and tenth, transversely inwards and upwards, and from the eleventh and twelfth, obliquely upwards. From these different origins the fibres run, like radii from the circumference to the centre of a circle; and are

Inserted into a cordiform tendon, of a considerable breadth, which is situated in the middle of the diaphragm, and in which, therefore, the fibres from opposite sides are interlaced. Towards the right side the tendon is perforated, by a triangular hole, for the passage of the vena cava inferior; and to the upper convex part of it the pericardium and mediastinum are connected.

The inferior, lesser muscle, or

Appendix of the Diaphragm,

Arises from the second, third and fourth lumbar vertebræ, by eight heads, of which, two in the middle, commonly called its *crura* are the longest, and begin tendinous. Between the crura, the aorta and thoracic duct pass; and on the outside of these, the great sympathetic nerves and branches of the vena azygos perforate the shorter heads. The muscular fibres run obliquely upwards and forwards, and form in the middle two fleshy columns, which decussate and leave an oval space between them for the passage of the œsophagus and eighth pair of nerves. Two bow shaped ligaments are formed on either side at the lower border of this muscle, as seen in fig 88.

Inserted, by strong fleshy fibres, into the posterior part of the middle tendon.

Use. The diaphragm is the principal agent in respiration, particularly in inspiration: for when it is in action, the fibres, from their different attachments, endeavour to bring themselves

a part of the greater muscle of the diaphragm. *g*, The arch formed in the interior of the thorax by the diaphragm: the position of this arch on the right side, is indicated by a dotted line. *h*, Columns, or crura of the lesser muscles of the diaphragm, arising from the lumbar vertebræ. *i*, Levatores costarum, longiores, and breviores.

into a plain towards the middle tendon, by which the cavity of the thorax is enlarged, particularly at the sides, where the lungs are chiefly situated; and as the lungs must always be contiguous to the inside of the thorax and upper side of the

Fig. 88.*

diaphragm, the air rushes into them, in order to fill up the increased space. This muscle is assisted by the two rows of

* The under or abdominal side of the diaphragm. 1, 2, 3. The greater muscle; the figure 1 rests upon the central leaflet of the tendinous centre; the number 2 on the left or smallest leaflet; and number 3 on the right leaflet. 4. The thin fasciculus which arises from the ensiform cartilage; a small triangular space is left on either side of this fasciculus, which is closed only by the serous membranes of the abdomen and chest. 5. The ligamentum arcuatum externum of the left side. 6. The ligamentum arcuatum internum. 7. A small arched opening occasionally found, through which the lesser splanchnic nerve passes. 8. The right or larger tendon of the lesser muscle; a muscular fasciculus from this tendon curves to the left side of the greater muscle between the œsophageal and aortic openings. 9. The fourth lumbar vertebra. 10. The left or shorter tendon of the lesser muscle. 11. The aortic opening occupied by the aorta, which is cut short off. 12. A portion of the œsophagus issuing through the œsophageal opening. 13. The opening for the inferior vena cava, in the tendinous centre of the diaphragm. 14. The psoas magnus muscle passing beneath the ligamentum arcuatum internum; it has been removed on the opposite side to show the arch more distinctly. 15. The quadratus lumborum passing beneath the ligamentum arcuatum externum; this muscle has been removed on the left side.

intercostals, which elevate the ribs, and the cavity of the thorax is more enlarged. In time of violent exercise, or whatever cause drives the blood with unusual celerity towards the lungs, the pectoral muscles, the serrati antici majores, the serati postici superiores, and scaleni muscles, are brought into action. These effect the lateral dilatation of the thorax. And in laborious inspiration, the muscles which arise from the upper part of the thorax, when the parts into which they are inserted are fixed, likewise assist. In expiration, the diaphragm is relaxed and pushed up by the pressure of the abdominal muscles upon the viscera of the abdomen; and at the same time that they press it upwards, they also, together with the sterno-costales and serrati postici inferiores, pull down the ribs, and are assisted, in a powerful manner, by the elasticity of the cartilages that join the ribs to the sternum; by which the cavity of the thorax is diminished, and the air suddenly pushed out of the lungs: and, in laborious expiration, the quadrati lumborum, sacro-lumbales, and longissimi dorsi, concur in pulling down the ribs. —The diaphragm, contributes the principal share to the dilatation of the chest during inspiration. When relaxed, the diaphragm is arched, and the top of the arch is nearly on a horizontal level with the anterior portion of the fourth rib, as seen in fig. 87, page 342. When contracted, the arch is flattened, (though the cordiform tendon itself, is but little depressed,) and the capacity of the thorax is increased, at the same time that the abdominal viscera are pressed downwards, so as to produce the protrusion of the abdomen observed during inspiration. The abdominal muscles and the diaphragm, usually antagonise each other, by contracting alternately. Occasionally they contract in unison, as in straining during defecation, parturition, &c., and compress the viscera and their contents, between the two planes which they form, with such force as to give rise at times to hernial protrusions.
—In natural tranquil inspiration, the dilatation of the chest is effected almost wholly by the diaphragm.—

The four pair are,

1. *Quadratus Lumborum.*

Arises, somewhat broad, tendinous and fleshy, from the posterior part of the spine of the os ilium.

Inserted into the transverse processes of all the vertebræ of the loins, into the last rib near the spine, and by a small tendon into the side of the last vertebra of the back.

Use. To move the loins to one side, pull down the last rib, and, when both act, to bend the loins forwards.

2. *Psoas Parvus.*

Arises, fleshy, from the sides of the two upper vertebræ of the loins, and sends off a small long tendon which ends thin and flat, and is

Inserted into the brim of the pelvis, at the junction of the os ilium and pubis.

Use. To assist the psoas magnus in bending the loins forwards; and, in certain positions, to assist in raising the pelvis.

N. B. This muscle is very often wanting.

3. *Psoas Magnus,*

Arises, fleshy, from the side of the body and transverse process of the last vertebra of the back; and, in the same manner, from those of the loins, by as many distinct slips. —At its superior portion, this muscle is covered by a thin fibrous expansion which is attached on the one hand to the points of the transverse processes, and on the other to the bodies of the upper lumbar vertebræ. This expansion, the *arcus interior* of Senac and Haller *(ligamentum arcuatum internum),* separates the psoas from the diaphragm. On the outer side of this is another aponeurotic arch, called *ligamentum arcuatum externum;* it passes from the outer extremity of the former, to the inferior margin of the last rib, embracing in its curve below, the quadratus lumborum muscle. Both these arches give origin on their upper margin to fibres of the lesser muscle of the diaphragm, and serve to cut off more effectually any communication between the thoracic and abdominal cavities.—

Inserted, tendinous, into the trochanter minor of the os femoris; and fleshy into that bone, a little below the same trochanter.

Use. To bend the thigh forwards; or, when the inferior extremity is fixed, to assist in bending the body.

4. *Iliacus Internus.*

Arises, fleshy, from the transverse process of the last vertebra of the loins, from all the inner lip of the spine of the os ilium, from the edge of that bone between its anterior spinous process and the acetabulum, and from most of the hollow part of the ilium. It joins with the psoas magnus, over the pubis, where it begins to become tendinous; and is

Inserted along with it on the trochanter minor.

Use. To assist the psoas in bending the thigh, and to bring it directly forwards.

N. B. The insertion of the two last muscles should not be traced till the muscles of the thigh are dissected.

Muscles situated within the Pelvis.

Of these there are two pair.

1. *Obturator Internus,*

Arises from more than one half of the internal circumference of the foramen thyroideum, formed by the os pubis and ischium, and from the upper part of the plane of the ischium, where it joins the ilium. Its inner face is covered by a portion of the levator ani; and appears to be divided into a number of fasciculi, which unite, and form a roundish tendon, that passes out of the pelvis, between the posterior sacro-ischiatic ligament and tuberosity of the os ischium; where it passes over the capsular ligament of the thigh bone, it is enclosed as in a sheath, by the gemini muscles.

Inserted, by a round tendon, into the large pit at the root of the trochanter major.

Use. To roll the os femoris obliquely outwards.

N. B. The insertion of this muscles should not be traced until the muscles of the thigh, to which it belongs, are dissected.

2. *Coccygeus.*

Arises, tendinous and fleshy, from the spinous process of the os ischium, and covers the inside of the posterior sacro-ischiatic ligament; from this narrow beginning, it gradually increases to form a thin fleshy belly, interspersed with tendinous fibres.

Inserted into the extremity of the os sacrum, and nearly the whole length of the os coccygis laterally.

Use. To support and move the os coccygis forwards, and to tie it more firmly to the sacrum.

Muscles situated on the Posterior Part of the Trunk.

These may be divided into four layers and a single pair. The *first* layer consists of two muscles, which cover almost the whole posterior part of the trunk.

Trapezius seu *Cucullaris,*

Arises, by a strong round tendon, from the lower part of the protuberance in the middle of the os occipitis behind; and, by a thin membranous tendon, which covers part of the splenius and complexus muscles from the rough curved line that extends from the protuberance towards the mastoid process of the temporal bone; runs down along the nape of the neck, where it seems to arise from its fellow, and covers the spinous processes of the superior vertebræ of the neck; it rises from the spinous processes of the two inferior cervical, and from the spinous processes of all the vertebræ of the back: adhering tendinous, to its fellow, *the whole length of its origin.* The junction of the tendons form a sort of elliptical expansion on the back of the neck.

Inserted, fleshy, into the posterior half of the clavicle; tendinous and fleshy, into the acromion, and into almost all the spine of the scapula.

Use. Moves the scapula according to the three different directions of its fibres: for the upper descending fibres draw it obliquely upwards; the middle transverse straight fibres draw

it directly backwards; and the inferior ascending fibres draw it obliquely downwards and backwards.

Fig. 89. *

* Muscles of the back; the superficial being shown upon the right, and the deeper seated on the left side. 1. The trapezius muscle. 2. The tendinous portion which with a corresponding portion in the opposite muscle, forms the tendinous ellipse on the back of the neck. 3. The acromion process and spine of the scapula. 4. The latissimus dorsi muscle. 5. The deltoid. 6. The muscles of the dorsum of the scapula, infra-spinatus, teres minor, and teres major. 7. The external oblique muscle. 8. The gluteus medius. 9. The glutei maximi. 10. The levator anguli scapulæ. 11. The rhomboideus minor. 12. The rhomboideus major. 13. The splenius capitis; the muscle immediately above, and overlaid by the splenius, is the complexus. 14. The splenius colli, only partially seen; the common origin of the splenius is seen attached to the spinous processes below the lower border of the rhomboideus major. 15. The vertebral aponeurosis. 16. The serratus posticus inferior. 17. The supra-spinatus muscle. 18. The infra-spinatus. 19. The teres minor muscle. 20. The teres major. 21. The long head of the triceps, passing between the teres minor and major to the upper arm. 22. The serratus magnus, proceeding forwards from its origin at the base of the scapula. 23. The internal oblique muscle.

N. B. Where it is inseparably united to its fellow in the nape of the neck, it is attached to the *Ligamentum Nuchæ,* or *Colli.* —This ligament is the representative of an important elastic ligament in quadrupeds which by its peculiar properties relieves the action of the muscles, in supporting the heavy pendant head. The two trapezii taken together, have some resemblance to the monk's cowl hanging over the neck, hence the name of cucullares given to them. When the trapezius is dissected on both sides, the two muscles represent a trapezium or diamond shaped quadrangle on the back of the shoulders. The anterior border of each muscle,forms in the neck the posterior boundary of the posterior triangle of the neck, so important to be understood in the operation upon the subclavian artery above the clavicle.—

2. *Latissimus Dorsi,*

Arises, by a broad thin tendon, from the posterior part of the spine of the os ilium, from all the spinous processes of the os sacrum and vertebræ of the loins, and from the seven inferior ones of the vertebræ of the back; also tendinous and fleshy, from the extremities of the three or four inferior ribs, a little beyond their cartilages, by as many distinct slips. The inferior fibres ascend obliquely, and the superior run transversely, over the inferior angle of the scapula, towards the axilla where they are collected, twisted, and folded. —Sometimes a few additional fibres of the muscle, arise from the inferior angle of the scapula.—

Inserted, by a strong thin tendon, into the inner edge of the groove for lodging the tendon of the long head of the biceps.

Use. To pull the arm backwards and downwards, and to roll the os humeri.

N. B. The insertion of this muscle should not be prosecuted till the muscles of the os humeri, to which it belongs, are dissected.

The second layer consists of three pair, two on the back, and one on the neck.

On the back:

1. *Serratus Posticus Inferior,*

Arises, by a broad thin tendon, in common with that of the latissimus dorsi, from the spinal process of the two inferior vertebræ of the back, and from the three superior vertebræ of the loins.

Inserted into the lower edge of the four inferior ribs, at a little distance from their cartilages, by as many distinct fleshy slips.

Use. To depress the ribs into which it is inserted.

2. *Rhomboideus.*

This muscle is divided into two portions.

1. *Rhomboideus major, arises*, tendinous, from the spinous processes of the five superior vertebræ of the back.

Inserted into all the basis of the scapula below its spine.

Use. To draw the scapula obliquely upwards, and directly inwards.

2. *Rhomboideus minor, arises*, tendinous, from the spinous processes of the three inferior vertebræ of the neck, and from the ligamentum nuchæ.

Inserted into the base of the scapula, opposite to its spine.

Use. To assist the former.

On the neck:

3. *Splenius,*

Arises, tendinous, from the four superior spinous processes of the vertebræ of the back: tendinous and fleshy, from the five inferior of the neck, and adheres firmly to the ligamentum nuchæ. At the third vertebra of the neck, the splenii recede from each other, so that part of the complexus muscle is seen.

Inserted, by as many tendons, into the five superior transverse processes of the vertebræ of the neck; and tendinous and fleshy, into the superior part of the mastoid process, and into the os occipitis, where it joins with the root of that process.

Use. To bring the head and upper vertebræ of the neck

backwards laterally: and, when both act, to pull the head directly backwards.

N. B. Albinus divides this muscle into two, viz. That portion which arises from the five inferior spinous processes of the neck, and is inserted into the mastoid process and os occipitis, he calls *splenius capitis ;* and that portion which arises from the third and fourth of the back, and is inserted into the five superior transverse processes of the neck, is called by him *splenius colli.*

The single pair,

Serratus Superior Posticus,

Arises, by a broad thin tendon, from the spinous processes of the three last vertebræ of the neck, and the two uppermost of the back.

Inserted into the second, third, fourth, and fifth ribs, by as many fleshy slips.

Use. To elevate the ribs, and dilate the thorax.

The *third* layer consists of three pair on the back, and three on the neck.

Those on the back are,

1. *Spinalis Dorsi,*

Arises from the spinous processes of the two uppermost vertebræ of the loins, and the three inferior of the back, by as many tendons.

Inserted into the spinous processes of the nine uppermost vertebræ of the back, except the first, by as many tendons.

Use. To erect and fix the vertebræ, and to assist in raising the spine.

2. *Longissimus Dorsi,*

Arises, tendinous without, and fleshy within, from the side, and all the spinous processes of the os sacrum ; from the posterior spine of the os ilium ; from all the spinous processes, and from the roots of the transverse processes of the vertebræ of the loins.

Inserted into all the transverse processes of the vertebræ of the back, chiefly by small double tendons ; also, by a tendinous and fleshy slip, into the lower edge of all the ribs, except the two inferior, at a little distance from their tubercles.

Use. To extend the vertebræ, and to raise and keep the trunk of the body erect.

N. B. From the upper part of this muscle, there runs up a round fleshy portion which joins with the cervicalis descendens.

3. *Sacro-Lumbalis,*

Arises, in common with the longissimus dorsi.

Inserted into all the ribs, where they begin to be curved forwards, by as many long and thin tendons ; and,

From the upper part of the six or eight lower ribs, arise as many bundles of thin fleshy fibres, which soon terminate in the inner side of this muscle, and are named *musculi ad sacro-lumbalem accessorii.*

Use. To pull the ribs down, and assist in erecting the trunk of the body.

N. B. There is a fleshy slip which runs from the upper part of this muscle into the fourth, fifth, and sixth transverse processes of the vertebræ of the neck, by three distinct tendons : it is named *cervicalis descendens ;* and *its* use is to turn the neck obliquely backwards, and to one side.

On the neck are,

1. *Complexus,*

Arises from the transverse processes of the seven superior vertebræ of the back, and four inferior of the neck, by as many distinct tendinous origins ; in its ascent, it receives a fleshy slip from the spinous process of the first vertebra of the back. From these different origins it runs upwards, and is every where intermixed with tendinous fibres.

Inserted, tendinous and fleshy, into the inferior edge of the protuberance in the middle of the os occipitis, and into a part of the curved line that runs forwards from that protuberance.

Use. To draw the head backwards, and to one side, and when both act, to draw the head directly backwards.

N. B. The long portion of this muscle that is situated next the spinous processes, lies more loose, and has a roundish tendon in the middle of it: for which reason Albinus calls it *biventer cervicis.*

2. *Trachelo-Mastoideus,*

Arises from the transverse processes of the three uppermost vertebræ of the back, and from the five lowermost of the neck, (where it is connected to the transversalis cervicis,) by as many thin tendons, which unite into a belly, and run up under the splenius.

Inserted into the middle of the posterior side of the mastoid process, by a thin tendon.

Use. To assist the complexus; but it pulls the head more to one side.

3. *Levater Scapulæ,*

Arises, tendinous and fleshy, from the transverse processes of the five superior vertebræ of the neck, by as many distinct slips, which soon unite to form a muscle that runs downwards and outwards.

Inserted, fleshy, into the superior angle of the scapula.

Use. To pull the scapula upwards and a little forwards.

The *fourth* layer consists of two pair on the back, two on the posterior part of the neck, four small pair situated immediately below the posterior part of the occiput, and three on the side of the neck.

On the back are,

1. *Semi-Spinalis Dorsi,*

Arises, from the transverse processes of the seventh, eighth, ninth, and tenth vertebræ of the back, by as many distinct tendons, which soon grow fleshy, and then become tendinous; and are

Inserted into the spinous processes of all the vertebræ of

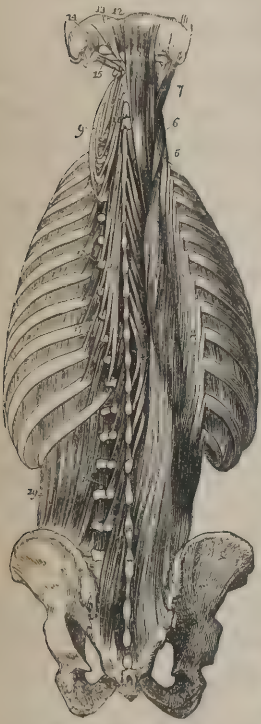
the back above the eighth, and into the two lowermost of the neck, by as many tendons.

Use. To extend the spine obliquely backwards.

2. *Multifidus Spinæ,*

Arises from the side and spinous processes of the os sacrum, and from the posterior part of the os ilium, where it joins with the sacrum; from all the oblique and transverse processes of the vertebræ of the loins; from all the transverse processes of the vertebræ of the back, and from those of the neck, except the three first, by as many distinct tendons, which soon grow fleshy, run in an oblique direction; and are

Fig. 90.*



Inserted, by distinct tendons, into all the spinous processes of the vertebræ of the loins, of the back, and of the neck, except the first.

Use. When the different portions of this muscle act on one side, they extend the back obliquely, or move it laterally; but if they act together on both sides, they extend the vertebræ backwards.

On the posterior part of the neck are,

* Deep seated muscles of the back. 1. The common origin of the erector spinæ muscle. Under which term is included three muscles, the sacro-lumbalis, longissimus dorsi, and spinalis dorsi. 2. The sacro-lumbalis. 3. The longissimus dorsi. 4. The spinalis dorsi. 5. The cervicalis ascendens. 6. The transversalis colli. 7. The trachelo-mastoideus. 8. The complexus. 9. The transversalis colli, showing its origin. 10. The semispinalis dorsi. 11. The semispinalis colli. 12. The rectus posticus minor. 13. The rectus posticus major. 14. The obliquus superior. 15. The obliquus inferior. 16. The multifidus spinæ. 17. The levatores costarum. 18. Intertransversales. 19. The quadratus lumborum.

1. *Semi-Spinalis Colli,*

Arises from the transverse processes of the uppermost six vertebræ of the back, by as many distinct tendons ascending obliquely under the complexus.

Inserted into the spinous processes of all the vertebræ of the neck, except the first and the last.

Use. To extend the neck obliquely backwards.

2. *Transversalis Colli,*

Arises from the transverse processes of the five uppermost vertebræ of the back, by as many tendinous and fleshy origins; runs between the trachelo mastoideus, and splenius colli and cervicalis descendens.

Inserted into the transverse processes of all the cervical vertebræ, except the first and the last.

Use. To turn the neck obliquely backwards, and a little to one side.

Below the posterior part of the occiput are,

1. *Rectus Capitis Posticus Major,*

Arises, fleshy, from the external part of the spinous process of the second vertebra of the neck, and grows broader in its ascent, which is not straight, but obliquely outwards.

Inserted, tendinous and fleshy, into the os occipitis, near the rectus capitis lateralis, and the insertion of the obliquus capitis superior.

Use. To pull the head backwards, and to assist a little in its rotation.

2. *Rectis Capitis Posticus Minor.*

Arises, by a narrow beginning, close to its fellow, from a little protuberance in the middle of the back part of the first vertebra of the neck, its outer edge being covered by the rectus major.

Inserted, somewhat broad, into the sides of a dimple in the os occipitis, near its foramen magnum.

Use. To assist the rectus major in moving the head backards.

3. *Obliquus Capitis Superior.*

Arises from the transverse process of the first vertebra of the neck.

Inserted, tendinous and fleshy, into the os occipitis behind the back part of the mastoid portion of the temporal bone, and under the insertion of the complexus muscle.

Use. To draw the head backwards.

4. *Obliquus Capitis Inferior.*

Arises, fleshy, from the spinous process of the second vertebra of the neck, its whole length; and, forming a thick fleshy belly, is

Inserted into the transverse process of the first vertebra of the neck.

Use. To give a rotary motion to the head.

On the side of the neck are,

1. *Scalenus Anticus,*

Arises from the fourth, fifth, and sixth transverse processes of the first vertebra of the neck, by as many tendons.

Inserted, tendinous and fleshy, into the upper side of the first rib near its cartilage.

2. *Scalenus Medius,*

Arises from all the transverse processes of the vertebra of the neck, by as many strong tendons; the nerves to the superior extremity pass between it and the former.

Inserted into the upper and outer part of the first rib, from its root, to within the distance of an inch from its cartilage.

3. *Scalenus Posticus,*

Arises from the fifth and sixth transverse processes of the vertebræ of the neck.

Inserted into the upper edge of the second rib, not far from the spine.

Use of the three scaleni; to bend the neck to one side; or,

when the neck is fixed, to elevate the ribs, and to dilate the thorax.

There are a number of small muscles situated between the spinous and transverse processes of contiguous vertebræ; which are accordingly named,

1. *Interspinales Colli.*

The space between the spinous processes of the vertebræ of the neck, most of which are bifurcated, is filled up with these fleshy portions; each of which

Arises, double, from the spinous process of the cervical vertebra below, and ascends to be

Inserted, in the same manner, into the spinous process of the vertebra above. They are five in number.

Use. To draw these processes nearer to each other.

2. *Intertransversales Colli.*

They begin from the transverse process of the first vertebra of the back, and fill up the spaces between the transverse processes of the vertebræ of the neck, which are likewise bifurcated; and, consequently, there are six distinct double muscles, which

Arise from the inferior transverse process of each vertebra of the neck, and first of the back, and are

Inserted into the transverse processes next above.

Use. To draw these processes towards each other, and turn the neck a little to one side.

Interspinales Dorsi et *Lumborum*, and the *Intertransversales Dorsi*,

Are rather small tendons than muscles, serving to connect the spinal and transverse processes.

Intertransversales Lumborum,

Are four distinct small bundles of flesh, which fill up the space between the transverse processes of the vertebræ of the loins, and serve to draw them towards each other.

MUSCLES OF THE SUPERIOR EXTREMITIES.

These may be divided into the muscles that are situated on the scapula, on the os humeri, on the cubit or forearm, and on the hand.

Muscles situated on the Scapula.

These are called *muscles* of the *os humeri;* and are three behind, one along its inferior costa, two before, and one beneath it.

Behind are,

1. *Supra-spinatus,*

Arises, fleshy, from all that part of the base of the scapula that is above its spine; also from the spine and superior costa; passes under the acromion, and adheres to the capsular ligament of the os humeri.

Inserted, tendinous, into that part of the large protuberance on the head of the os humeri, that is next the groove for lodging the tendon of the long head of the biceps.

Use. To raise the arm upwards; and, at the same time, to pull the capsular ligament from between the bones, that it may not be pinched.

2. *Infra spinatus,*

Arises, fleshy, from all that part of the base of the scapula that is between its spine and inferior angle; and from the spine as far as the cervix of the scapula. The fibres ascend and descend obliquely towards a tendon in the middle of the muscle, which runs forwards, and adheres to the capsular ligament.

Inserted, by a thick and short tendon, into the upper and middle part of the large protuberance on the head of the os humeri.

Use. To roll the humerus outwards: to assist in raising, and in supporting it when raised; and to pull the ligament from between the bones.

N. B. These two muscles are covered with a tendinous membrane, from which a number of their fleshy fibres arise. It serves besides to strengthen their actions, and keeps them from swelling too much outwardly when in action.

3. *Teres Minor,*

Arises, fleshy, from all the round edge of the inferior costa of the scapula, and runs forwards along the inferior edge of the infra-spinatus muscle, and adheres to the ligament.

Inserted, tendinous, into the back part of the large protuberance on the head of the os humeri, a little behind and below the termination of the last named muscle.

Use. To roll the humerus outwards, to draw the humerus backwards; and to prevent the ligament from being pinched between the bones.

Along the inferior costa of the scapula is,

Teres Major,

Arises, fleshy, from the inferior angle of the scapula, and from all that portion of its inferior costa that is rough and thicker than the rest; its fleshy fibres are continued over part of the infra-spinatus muscle, to which they firmly adhere.

Inserted, by a broad, short, and thin tendon, into the ridge at the inner side of the groove for lodging the tendon of the long head of the biceps, along with the latissimus dorsi.

Use. To roll the humerus inwards, and to draw it backwards and downwards.

The two before the scapula are,

1. *Deltoides,*

Arises, fleshy, from all the posterior part of the clavicle that the pectoralis major does not occupy; tendinous and fleshy, from the acromion, and lower margin of almost the whole spine of the scapula opposite to the insertion of the cucullaris muscle; from the origins it runs in three different directions, i. e. from the clavicle outwards and downwards; from the

spine of the scapula outwards, forwards, and downwards; and from the acromion, straight downwards; and is composed of a number of fasciculi, which form a strong fleshy muscle that covers the anterior part of the joint of the os humeri.

Inserted, tendinous, into a rough protuberance in the outer side of the os humeri, near its middle, where the fibres of this muscle intermix with some part of the brachialis externus.

Use. To pull the arm directly outwards and upwards, and a little forwards or backwards, according to the different directions of its fibres.

2. *Coraco-Brachialis,*

Arises, tendinous and fleshy, from the forepart of the coracoid process of the scapula; adhering in its descent, to the short head of the biceps.

Inserted, tendinous and fleshy, about the middle of the internal part of the os humeri, near the origin of the third head of the triceps, called *brachialis externus*, where it sends down a thin tendinous expansion to the internal condyle of the os humeri.

Use. To raise the arm upwards and forwards.

N. B. There passes a nerve through this muscle, called *musculo cutaneus*.

The one beneath the scapula is,

Subscapularis,

Arises, fleshy, from all the base of the scapula, internally, and from its superior and inferior costæ, being composed of a number of tendinous and fleshy fasciculi, which make prints on the bone; they all join together, fill up the hollow of the scapula, and pass over the joint, adhering to the capsular ligament.

Inserted, tendinous, into the upper part of the internal protuberance at the head of the os humeri.

Use. To roll the humerus inwards, and to draw it to the side of the body; and to prevent the capsular ligament from being pinched.

Muscles situated on the Os Humeri.

These are called

Muscles of the Cubit or Forearm.

They consist of two before, and two behind.
Before are,

Fig. 91.*

1. *Biceps Flexor Cubiti,*

Arises, by two heads. The first and outermost called *longus*, begins tendinous from the upper edge of the glenoid cavity of the scapula, passes over the head of the os humeri within the joint; and, in its descent without the joint, is enclosed in a groove near the head of the os humeri, by a membranous ligament that proceeds from the capsular ligament and adjacent tendons. The second or innermost head, called *brevis*, arises tendinous and fleshy, from the coracoid process of the scapula, in common with the coraco-brachialis muscle. A little below the middle of the forepart of the os humeri, these heads unite.

Inserted, by a strong roundish tendon, into the tubercle on the upper end of the radius internally.

Use. To turn the hand supine, and to bend the forearm.

N. B. At the bending of the elbow, where it begins to grow tendinous, it sends off an aponeurosis which covers all the muscles on the inside of the forearm, and joins with another tendinous membrane, which is sent off from the triceps extensor cubiti, covers all the muscles on the outside of the

* The muscles of the anterior aspect of the upper arm. 1. The coracoid process of the scapula. 2. The coraco-clavicular ligament (trapezoid), passing upwards to the scapular end of the clavicle. 3. The coraco-acromial ligament, passing outwards to the acromion. 4. The subscapularis muscle. 5. The teres major. 6. The coraco-brachialis. 7. The biceps. 8. The upper end of the radius. 9. The brachialis anticus. 10. The internal head of the triceps.

forearm, and a number of the fibres, from opposite sides, decussate each other. It serves to strengthen the muscles, by keeping them from swelling too much outwardly, when in action; and a number of their fleshy fibres take their origin from it.

2. *Brachialis Internus,*

Arises, fleshy, from the middle of the os humeri, at each side of the insertion of the deltoid muscle, covering all the inferior and forepart of this bone, runs over the joint and adheres firmly to the ligament.

Fig. 92.

Inserted, by a strong tendon, into the coronoid process of the ulna.

Use. To bend the forearm, and to prevent the capsular ligament of the joint from being pinched.

Behind, are

1. *Triceps Extensor Cubiti,*

Arises, by three heads; the first called *longus*, somewhat broad and tendinous, from the inferior costa of the scapula, near its cervix. The second head, called *brevis*, arises by an acute, tendinous, and fleshy beginning, from the back part of the os humeri, a little below its head, outwardly. The third, called *brachialis externus*, arises by an acute beginning, from the back part of the os humeri. These three heads unite lower than the insertion of the teres major, and cover the whole posterior part of the humerus, from which they receive addition in their descent.

[*] A posterior view of the arm, showing the triceps extensor cubiti muscle. 1. Its external head called *brevis*. 2. Its long or scapular head. 3. Its internal head, called in contradistinction with a muscle on the front of the arm, *brachialis externus*. 4. The olecranon process of the ulna. 5. The radius. 6. The capsular ligament of the shoulder joint.

Inserted into the upper and external part of the process of the ulna, called *olecranon*, and partly into the condyles of the os humeri, adhering firmly to the ligament.

Use. To extend the forearm.

2. *Anconeus,*

Arises, tendinous, from the posterior part of the external condyle of the os humeri; it soon grows fleshy, and is continued from the third head of the triceps.

Inserted, fleshy, and thin into a ridge on the outer and posterior edge of the ulna, being continued some way before the olecranon, and covered with a tendinous membrane.

Use. To assist in extending the forearm.

Muscles situated on the Forearm.

These may be divided into three classes, viz.

1. The muscles which bend and extend the wrist, and of course the whole hand.
2. Those which bend and extend the fingers exclusively.
3. Those which act on the radius so as to roll it backwards and forwards on the ulna; which are called supinators and pronators.

The flexors both of the wrist and fingers, and the pronators, lie on the front of the forearm. The extensors and the supinators on the back.

The flexors generally originate from the internal condyle of the os humeri, and the parts adjacent to it; the extensors from the external condyle of the same bone, and the parts which are near it.

In the following description they are arranged in the order in which they occur in the dissection of the arm; beginning with those which originate with the internal condyle, without regard to their particular functions.

Muscles on the anterior part of the Forearm.

1. *Palmaris Longus,*

Arises, tendinous, from the internal condyle of the os humeri, soon grows fleshy, and, after a short progress sends off a long slender tendon.

Inserted into the ligamentum carpi annulare, and into a tendinous membrane that is expanded on the palm of the hand, named *aponeurosis palmaris;* which, above, begins at the transverse or annular ligament of the wrist, and, below, is fixed to the roots of the fingers.

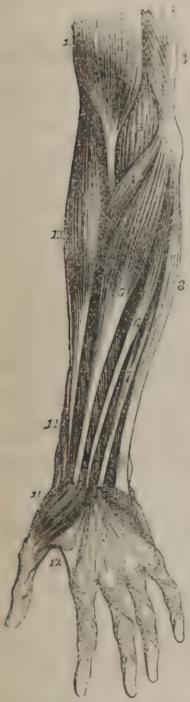
Use. To bend the hand, and to stretch the membrane that is expanded on the palm.

N. B. This muscle is sometimes wanting, but the aponeurosis palmaris is always to be found.

2. *Pronator Radii Teres,*

Arises, fleshy, from the internal condyle of the os humeri, and tendinous from the coronoid process of the ulna.

Fig. 93.*



Inserted, thin, tendinous, and fleshy, into the middle of the posterior part of the radius.

Use. To roll the radius, together with the hand, inwards.

3. *Flexor Carpi Radialis,*

Arises, tendinous and fleshy, from the internal condyle of the os humeri, and from the anterior part of the upper end of the ulna, where it firmly adheres to the pronator radii teres.

Inserted, by a flat tendon, into the fore and upper part of the metacarpal bone that sustains the forefinger, after running through a fossa in the os trapezium.

Use. To bend the hand, and to assist in its pronation.

4. *Flexor Carpi Ulnaris,*

Arises, tendinous, from the internal condyle of the os humeri. It has, likewise, a small fleshy beginning from the outer side

* Superficial layer of muscles of the fore-arm. 1. The lower part of the biceps, with its tendon. 2. A part of the brachialis anticus, seen beneath the biceps. 3. A part of the triceps. 4. The pronator radii teres. 5. The flexor carpi radialis. 6. The palmaris longus. 7. One of the fasciculi of the flexor sublimis digitorum; the rest of the muscle is seen beneath the tendons of the palmaris longus and flexor carpi radialis. 8. The flexor carpi ulnaris. 9. The palmar fascia. 10. The palmaris brevis muscle. 11. The abductor pollicis muscle. 12. One portion of the flexor brevis pollicis; the leading line crosses a part of the abductor pollicis. 13. The supinator longus muscle. 14. The extensor ossis metacarpi, and extensor primi internodii pollicis, curving around the lower border of the fore-arm.

of the olecranon, between which, and the origin from the condyle, there is a space left, through which the ulnar nerve passes to the forearm; and a number of its fleshy fibres arise from the tendinous membrane that covers the forearm.

Fig. 94.*

Inserted, by a short strong tendon, into the os pisiforme. At a little distance from its insertion, a small ligament is sent off to the metacarpal bone that sustains the little finger.

Use. To assist the former in bending the arm.

5. *Flexor Sublimis Perforatus,*

Arises, tendinous and fleshy, from the internal condyle of the os humeri; tendinous from the coronoid process of the ulna, near the edge of the cavity that receives the head of the radius; fleshy from the tubercle of the radius; and membranous and fleshy from the middle of the forepart of the radius, where the flexor pollicis longus arises. Its fleshy belly sends off four round tendons before it passes under the ligament of the wrist.

Inserted into the anterior and upper part of the second bone of each finger, being near the extremity of the first bone, and divided for the passage of the perforans.

Use. To bend the second joint or phalanx of the fingers.

6. *Flexor Profundus Perforans,*

Arises, fleshy, from the external side, and upper part of the

* The deep layer of muscles on the forearm. 1. The internal lateral ligament of the elbow joint. 2. The anterior ligament. 3. The orbicular ligament of the head of the radius. 4. The flexor profundus digitorum muscle. 5. The flexor longus pollicis. 6. The pronator quadratus. 7. The adductor pollicis muscle. 8. The dorsal interosseous muscle of the middle finger, and palmar interosseous of the ring finger. 9. The dorsal interosseous muscle of the ring finger and palmar interosseous of the little finger.

ulna, for some way downwards, and from a large share of the interosseous ligament. It splits into four tendons, a little before it passes under the ligamentum carpi annulare; and these pass through the slits in the tendons of the flexor sublimis.

Inserted into the fore and upper part of the third or last bone of all the four fingers.

Use. To bend the last joint of the fingers.

7. *Flexor Longus Pollicis Manus,*

Arises, by an acute fleshy beginning, from the upper part of the radius, immediately below its tubercle, and is continued down for some space on the forepart of this bone. It has likewise generally another origin from the internal condyle of the os humeri, which forms a distinct fleshy slip, that terminates near the upper part of the origin from the radius.

Inserted into the last joint of the thumb, after having passed its tendon under the ligament of the wrist.

Use. To bend the last joint of the thumb.*

8. *Prenator Radii Quadratus,*

Arises, broad, tendinous, and fleshy from the lower and inner part of the ulna; the fibres run transversely, to be

Inserted into the lower and anterior part of the radius, opposite to its origin.

Use. To turn the radius, together with the hand, inwards.

Muscles of the External Side and Back of the Arm.

1. *Supinator Radii Longus,*

Arises, by an acute and fleshy origin, from the external ridge of the os humeri, above the external condyle, nearly as far up as the middle of that bone.

* The thumb has but one flexor muscle on the front of the arm, although it has three extensors on the back part. —No animal but man has a distinct flexor longus pollicis muscle. In the monkey even, its place is supplied by a branch of the communis digitorum tendons; man only can bring the thumb in direct opposition to the fingers, and make the hand a perfect instrument of prehension.—P.

Fig. 95.*

Inserted into the outer side of the inferior extremity of the radius.

Use. To roll the radius outwards, and consequently the palm of the hand upwards.

2. *Extensor Carpi Radialis Longior,*

Arises, broad, thin, and fleshy, immediately below the supinator radii longus, from the lower part of the external ridge of the os humeri, above its external condyle.

Inserted, by a round tendon, into the posterior and upper part of the metacarpal bone that sustains the fore-finger.

Use. To extend and bring the hand backwards.

3. *Extensor Carpi Radialis Brevior,*

Arises, tendinous, from the external condyle of the os humeri, and from the ligament that connects the radius to it, and runs along the outside of the radius.

Inserted, by a round tendon, into the upper and back part of the metacarpal bone that sustains the middle finger.

Use. To assist the last mentioned muscle.

4. *Extensor Carpi Ulnaris,*

Arises, tendinous from the external condyle of the os humeri,

* The superficial layer of muscles on the posterior aspect of the fore-arm. 1. The lower part of the biceps. 2. Part of the brachialis anticus. 3. The lower part of the triceps, inserted into the olecranon. 4. The supinator longus. 5. The extensor carpi radialis longior. 6. The extensor carpi radialis brevior. 7. The tendons of insertion of these two muscles. 8. The extensor communis digitorum. 9. The extensor minimi digiti. 10. The extensor carpi ulnaris. 11. The anconeus. 12. Part of the flexor carpi ulnaris. 13. The extensor ossis metacarpi and extensor primi internodii muscle, lying together. 14. The extensor secundi internodii; its tendon is seen crossing the two tendons of the extensor carpi radialis longior and brevior. 15. The posterior annular ligament. The tendons of the common extensor are seen upon the back of the hand, and their mode of distribution on the dorsum of the fingers.

and in its progress, fleshy, from the middle of the ulna, where it passes over the ulna. Its round tendon is enclosed by a membranous sheath, in a groove which is situated at the extremity of the ulna.

Inserted, by its round tendon, into the posterior and upper part of the metacarpal bone that sustains the little finger.

Use. To assist the former in extending the hand.

5. *Extensor Digitorum Communis*,

Arises, by an acute, tendinous, and fleshy beginning, from the external condyle of the os humeri, where it adheres to the supinator radii brevis. Before it passes under the ligamentum carpi annulare externum, it splits into four tendons; some of which may be divided into several smaller; and about the forepart of the metacarpal bones they remit tendinous filaments to each other.

Inserted into the posterior part of all the bones of the four fingers, by a tendinous expansion.

Use. To extend all the joints of the fingers.

6. *Supinator Radii Brevis*,

Arises, tendinous, from the external condyle of the os humeri; tendinous and fleshy, from the external and upper part of the ulna, and adheres firmly to the ligament that joins these two bones.

Inserted, into the head, neck, and tubercle of the radius, near the insertion of the biceps, and into the ridge running from that downwards and outwards.

Use. To roll the radius outwards, and so bring the hand supine.

7. *Indicator*,

Arises, by an acute fleshy beginning, from the middle of the posterior part of the ulna; its tendon passes under the same ligament with the extensor digitorum communis, with part of which it is

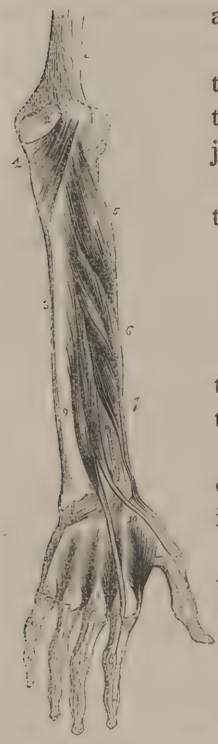
Inserted into the posterior part of the fore-finger.

Use. To extend the fore-finger separately.

8. *Extensor Ossis Metacarpi Pollicis Manus.*

Arises, fleshy, from the middle and posterior part of tne ulna, immediately below the insertion of the anconeus muscle, from the posterior part of the middle of the radius, and from the interosseous ligament.

Fig. 96.*



Inserted, generally by two tendons, into the os trapezium, and upper back part of the metacarpal bone of the thumb, and often joins with the adductor pollicis.

Use. To extend the metacarpal bone of the thumb, outwardly.

9. *Extensor Primi Internodii, (Ext. Major Pollicis Manus,)*

Arises, fleshy, from the posterior part of the ulna near the former muscle, and from the interosseous ligament.

Inserted, tendinous, into the posterior part of the first bone of the thumb; and a part of it may be traced as far as the second bone.

Use. To extend the first bone of the thumb obliquely outwards.

10. *Extensor Secundi Internodii, (Ext. Minor Pollicis Manus,)*

Arises, by an acute, tendinous, and fleshy beginning, from the middle back part of the ulna, and from the interosseous ligament; its tendon runs through a small groove at the inner and back part of the lower end of the radius.

Inserted into the last bone of the thumb.

Use. To extend the last joint of the thumb obliquely backwards.

* The deep layer of muscles on the posterior aspect of the fore-arm. 1. The lower part of the humerus. 2. The olecranon. 3. The ulna. 4. The anconeus muscle. 5. The supinator brevis muscle. 6. The extensor ossis metacarpi pollicis. 7. The extensor primi internodii pollicis. 8. The extensor secundi internodii pollicis. 9. The extensor indicis. 10. The first dorsal interosseous muscle. The other three dorsal interossei are seen between the metacarpal bones of their respective fingers.

Muscles on the Palm of the Hand.

To obtain a full view of the muscles situated on the palm of the hand, it will be necessary to remove the annular or transverse ligament, which is stretched across from the projecting points of the pisiform and unciform bones on the inside of the wrist to the scaphoid and trapezium on the outside; for the purpose of retaining the tendons of the flexor muscles in their proper situation. And also, to remove from the palm of the hand the aponeurosis palmaris, which has been described with the palmaris longus muscle.

1. *Palmaris Brevis.*

Arises from the ligamentum carpi annulare, and the aponeurosis that is expanded on the palm of the hand.

Inserted, by small bundles of fleshy fibres, into the skin and fat that cover the adductor minimi digiti, and into the os pisiforme.

Use. To assist in contracting the palm of the hand.

2. *Abductor Pollicis Manus,*

Arises, by a broad tendinous and fleshy beginning, from the ligamentum carpi annulare, and from the os trapezium.

Inserted, tendinous, into the outer side of the root of the first phalanx of the thumb.

Use. To draw the thumb from the fingers.

3. *Flexor Ossis Metacarpi Pollicis,* or *Opponens Pollicis,*

Arises, fleshy, from the os trapezium and ligamentum carpi annulare, lying under the adductor pollicis.

Inserted, tendinous and fleshy, into the under and anterior part of the metacarpal bone of the thumb.

Use. To bring the thumb inwards, opposite to the other finger.

4. *Flexor Brevis Pollicis Manus,*

Is divided into two portions by the tendon of the flexor longus pollicis, and is placed beneath the adductor, and at the side of the opponens. It is divided into two heads. The first arises fleshy from the volar sides of the trapezium, trapezoides, and from the contiguous part of the internal surface of the

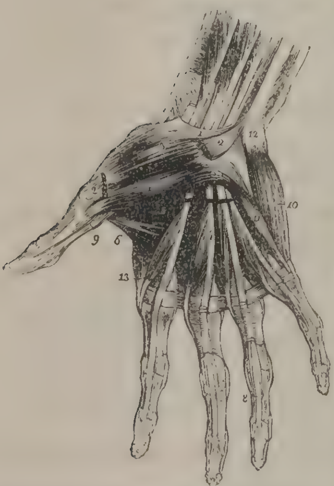
annular ligament. The second head arises from the magnum, unciforme, and from the base of the metacarpal bone of the middle finger.

Inserted, by the first head into the outer sesamoid bone, and by the second into the inner sesamoid bones. These bones act the parts of patellæ, by having a tendinous connexion with the first phalanx of the thumb.

Use. To bend the first joint of the thumb.

5. *Adductor Pollicis Manus*,

Fig. 97.*



Arises, fleshy, from almost the whole length of the metacarpal bone that sustains the middle finger; from thence its fibres are collected together.

Inserted, tendinous, into the inner part of the root of the first phalanx of the thumb.

Use. To pull the thumb towards the fingers.

There are four small flexors, called, from their form,

6. *Lumbricales*,

Which *arise*, thin and fleshy, from the outside of the tendons of the flexor profundus, a little above the lower edge of the ligamentum carpi annulare.

* The muscles of the hand. 1. The annular ligament. 2, 2. The origin and insertion of the abductor pollicis muscle; the middle portion has been removed. 3. The flexor ossis metacarpi, or opponens pollicis. 4. One portion of the flexor brevis pollicis. 5. The deep portion of the flexor brevis pollicis. 6. The adductor pollicis. 7, 7. The lumbricales muscles, arising from the deep flexor tendons, upon which the numbers are placed. The tendons of the flexor sublimis have been removed from the palm of the hand. 8. One of the tendons of the deep flexor, passing between the two terminal slips of the tendon of the flexor sublimis to reach the last phalanx. 9. The tendon of the flexor longus pollicis, passing between the two portions of the flexor brevis to the last phalanx. 10. The abductor minimi digiti. 11. The flexor brevis minimi digiti. The edge of the flexor ossis metacarpi, or adductor minimi digiti, is seen projecting beyond the inner border of the flexor brevis. 12. The prominence of the pisiform bone. 13. The first dorsal interosseous muscle.

Inserted, by long slender tendons, into the outer sides of the broad tendons of the interossei muscles, about the middle of the first joint.

Use. To increase the flexion of the fingers while the long flexors are in full action.

7. *Adductor Metacarpi Minimi Digiti Manus,*

Arises, fleshy from the thin edge of the os unciforme, and from that part of the ligament of the wrist next to it.

Inserted, tendinous, into the inner side and anterior part of the metacarpal bone of this finger.

Use. To bend and bring the metacarpal bone of this finger towards the wrist.

8. *Flexor Parvus Minimi Digiti,*

Arises, fleshy, from the outer side of the os unciforme, and from the ligament of the wrist which joins with that bone.

Inserted, by a roundish tendon, into the inner and anterior part of the upper end of the first bone of this finger.

Use. To bend the little finger, and assist the adductor.

9. *Abductor Minimi Digiti Manus.*

Arises, fleshy, from the os pisiforme, and from that part of the ligamentum carpi annulare next it.

Inserted, tendinous, into the inner side of the upper end of the first bone of the little finger.

Use. To draw this finger from the rest.

The spaces between the metacarpal bones are occupied by muscles, called, from their situation, *interosseous.* The four following are to be seen on the palm of the hand.

Anterior Interosseous Muscles.

1. *Prior Indicis.*

Arises, tendinous and fleshy, from the upper and outer part of the metacarpal bone that sustains the fore-finger.

Inserted into the outside of that part of the tendinous

expansion from the extensor digitorum communis, which covers the posterior part of the fore-finger.

Use. To draw the fore-finger outwards towards the thumb, and extend it obliquely.

2. *Posterior Indicis.*

Arises tendinous and fleshy, from the root and inner part of the metacarpal bone that sustains the fore-finger.

Inserted into the inner side of the tendinous expansion which is sent off from the extensor digitorum communis, along the posterior part of the fore-finger.

Use. To extend the fore-finger obliquely, and to draw it inwards.

3. *Prior Annularis.*

Arises, from the root of the outside of the metacarpal bone that sustains the ring finger.

Inserted into the outside of the tendinous expansion of the extensor digitorum communis which covers the ring finger.

Use. To extend and pull the ring finger towards the thumb.

4. *Interosseous Auricularis,*

Arises, from the root and outer side of the metacarpal bone of the little finger; and is

Inserted into the outside of the tendinous expansion of the extensor digitorum communis, which covers the posterior part of the little finger.

Use. To extend and draw the little finger outwards.

On the back of the hand three muscles of the same kind are to be seen, which also appear on the palm.

Posterior Interosseous Muscles.

1. *Prior Medii,*

Arises, by two origins, from the root of the metacarpal bones that sustain the fore and middle fingers externally, and next each other: runs along the outside of the middle finger; and, being conspicuous on both sides of the hand, is

Inserted into the outside of the tendinous expansion from the extensor digitorum communis, which covers the posterior part of the middle finger.

Use. To extend and to draw the middle finger outwards.

2. *Posterior Medii,*

Arises, by two origins, from the roots of the metacarpal bones next each other, that sustain the middle and ring fingers.

Inserted into the inside of the tendinous expansion from the extensor digitorum communis, which runs along the posterior part of the middle finger.

Use. To extend and draw the middle finger inwards.

3. *Posterior Annularis,*

Arises, by two origins, from the roots of the metacarpal bones that sustain the ring and little fingers, next each other.

Inserted into the inside of the tendon on the back of the ring finger.

Use. To draw the ring finger inward.

The following muscle also appears on the back of the hand.

Adductor Indicis Manus,

Arises, from the os trapezium, and from the superior part and inner side of the metacarpal bone of the thumb.

Inserted, by a short tendon, into the outer and back part of the first bone of the fore finger.

Use. To bring the fore finger towards the thumb.

MUSCLES OF THE INFERIOR EXTREMITIES.

These may be divided into the muscles *situated* on the *outside* of the *pelvis,* on the *thigh,* on the *leg,* and on the *foot.*

The muscles on the outside of the *pelvis,* which are called *muscles of the thigh,*

Are composed of *one layer before* and *three layers behind.*

The layer before consists of five muscles:

1. *Psoas Magnus.* } See p. 346, 347.
2. *Iliacus Internus.* }

3. *Pectinalis,*

Arises, broad and fleshy, from the upper and anterior part of the os pubis or pectinis, immediately above the foramen thyroideum.

Inserted into the anterior and upper part of the linea aspera of the os femoris, a little below the trochanter minor, by a flat and short tendon.

Use. To bring the thigh upwards and inwards, and to give it a degree of rotation outwards.

4. *Triceps Adductor Femoris,*

Under this appellation are comprehended three distinct muscles:

a. *Adductor Longus Femoris,*

Arises, by a strong roundish tendon, from the upper and anterior part of the os pubis, and from the symphysis pubis, on the inner side of the pectinalis.

Inserted, tendinous, near the middle of the posterior part of the linea aspera, being continued for some way down.

b. *Adductor Brevis Femoris,*

Arises, tendinous, from the os pubis near its joining with the opposite os pubis, below and behind the former.

Inserted, tendinous and fleshy, into the inner and upper part of the linea aspera, from a little below the trochanter minor, to the beginning of the insertion of the adductor longus.

c. *Adductor Magnus Femoris,*

Arises, a little lower down than the former, near the symphysis of the ossa pubis, tendinous and fleshy from the tuberosity of the os ischium; the fibres run outwards and downwards.

Inserted into almost the whole length of the linea aspera; into a ridge above the internal condyle of the os femoris; and, by a roundish long tendon, into the upper part of that condyle,

a little above which, the femoral artery takes a spiral turn towards the ham, passing between this muscle and the bone.

Use of these three muscles, or triceps. To bring the thigh inwards and upwards, according to the different directions of their fibres; and, in some degree, to roll the thigh outwards.

5. *Obturator Externus,*

Arises, fleshy, from the lower part of the os pubis, and fore-part of the inner crus of the ischium; surrounds the foramen thyroideum; a number of its fibres, arising from the membrane which fills up that foramen, are collected like rays towards a centre, and pass outwards around the root of the back part of the cervix of the os femoris.

Inserted, by a strong tendon, into the cavity at the inner and back part of the root of the trochanter major, adhering in its course to the capsular ligament of the thigh bone.

Use. To roll the thigh bone obliquely outwards, and to prevent the capsular ligament from being pinched.

Behind are,

First layer,

Gluteus Maximus,

Arises, fleshy, from the posterior part of the spine of the os ilium, a little higher up than the joining of the ilium with the os sacrum, from the whole external side of the os sacrum, below the posterior spinous process of the os ilium; from the posterior sacro-ischiatic ligament, over which part of the inferior edge of this muscle hangs in a folded manner, and from the os coccygis. All the fleshy fibres run obliquely forwards, and a little downwards, to form a thick broad muscle, which is divided into a number of strong fasciculi. The upper part of it covers almost the whole of the trochanter major, between which and the tendon of this muscle there is a large bursa mucosa, and where it is inseparably joined to the broad tendon of the *tensor vaginæ femoris*.

Inserted, by a strong, thick, and broad tendon, into the upper and outer part of the linea aspera, which is continued from the

trochanter major, for some way downwards, as far as the origin of the short head of the biceps flexor cruris—and also into the fascia femoris.

Use. To extend the thigh, by pulling it directly backwards, and a little outwards.

Second layer,

Gluteus Medius,

Arises, fleshy, from the anterior superior spinous process of the os ilium, and from all the outer edge of the spine of the ilium; except its posterior part, where it arises from the dorsum of that bone.

Inserted, by a broad tendon, into the outer and upper margin of the trochanter major.

Use. To draw the thigh bone outwards, and a little backwards; to roll the thigh bone outwards, especially when it is bended.

N. B. The anterior and upper part of this muscle is covered by a tendinous membrane, from which a number of its fleshy fibres arise, and which joins with the broad tendons of the gluteus maximus, tensor vaginæ femoris, and latissimus dorsi.

Third layer consists of four muscles.

1. *Gluteus Minimus.*

Arises, fleshy, from a ridge that is continued from the superior anterior spinous process of the os ilium, and from the middle of the dorsum of that bone, as far back as its great niche.

Inserted, by a strong tendon, into the fore and upper part of the trochanter major.

Use. To assist the former in pulling the thigh outwards and backwards, and in rolling it.

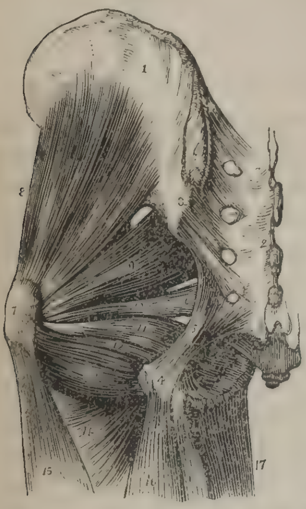
2. *Pyriformis.*

Arises, within the pelvis, by three tendinous and fleshy origins, from the second, third, and fourth pieces of the os sacrum; from thence growing gradually narrower, it passes out of the

pelvis along with the posterior crural nerve, below the niche in the posterior part of the os ilium, where it receives a few fleshy fibres.

Inserted, by a roundish tendon, into the upper part of the cavity, at the inner side of the root of the trochanter major.

Fig. 98.*



Use. To move the thigh a little upwards, and roll it outwards.

3. *Gemelli*,

Arise, by two distinct origins; the superior from the spinous process, and the inferior from the tuberosity of the os ischium; also, from the posterior sacro-ischiatic ligament. They are both united by a tendinous fleshy membrane, and form a purse for the tendon of the obturator internus muscle, which was formerly described.

Inserted, tendinous and fleshy, into the cavity at the inner side of the root of the trochanter major, on each side of the tendon of the obturator internus, to which they firmly adhere.

Use. To roll the thigh outwards, and to preserve the tendon of the obturator internus from being hurt by the hardness of that part of the os ischium over which it passes; also, to hinder it from starting out of its place, while the muscle is in action.

* The deep muscles of the gluteal region. 1. The external surface of the ilium. 2. The posterior surface of the sacrum. 3. The posterior sacro-iliac ligaments. 4. The tuberosity of the ischium. 5. The great or posterior sacro-ischiatic ligament. 6. The lesser or anterior sacro-ischiatic ligament. 7. The trochanter major. 8. The gluteus minimus. 9. The pyriformis. 10. The gemellus superior. 11. The obturator internus muscle, passing out of the lesser sacro-ischiatic foramen. 12. The gemellus inferior. 13. The quadratus femoris. 14. The upper part of the adductor magnus. 15. The vastus externus. 16. The biceps. 17. The gracilis. 18. The semi-tendinosus.

4. *Quadratus Femoris,*

Arises, tendinous and fleshy, from the outside of the tuberosity of the os ischium; and, running transversely, is

Inserted, fleshy, into a rough ridge, continued from the root of the large trochanter to the root of the small one.

Use. To roll the thigh outwards.

Muscles situated on the Thigh.

These are called *muscles* of the *leg;* and consist of *one*, on the *outside; two* on the *inside; four, before;* and *four, behind.*

Previous to the description of the muscles that are situated on the thigh and leg, it is necessary to take notice of a broad tendinous fascia or sheath, *(aponeurosis of the lower extremities,)* which is sent off from the back and from the tendon of the glutei and adjacent muscles.

It is a strong thick membrane on the outside of the thigh and leg; but, towards the inside of both, it gradually turns thinner, and has rather the appearance of cellular substance than a tendinous membrane. A little below the trochanter major, it is firmly fixed to the linea aspera; and, farther down, to that part of the head of the tibia that is next the fibula; where it sends off the tendinous expansion along the outside of the leg.

It serves to strengthen the action of the muscles, by keeping them firm in their proper places while in action, particularly the tendons that pass over the joints where this membrane is thickest, and it gives origin to a number of the fleshy fibres of the muscles.

On the outside is,

Tensor Vaginæ Femoris,

Arises, by a narrow, tendinous, and fleshy beginning, from the external part of the anterior superior spinous process of the os ilium.

Inserted, a little below the trochanter major, into the inner side of the membranous fascia which covers the outside of the thigh.

*Fig. 99.**

Use. To stretch the membranous fascia, to assist in the adduction of the thigh, and somewhat in its rotation inwards.

On the inside are,

1. *Sartorius,*

Arises, tendinous, from the anterior superior spinous process of the os ilium, soon grows fleshy, runs down for some space upon the rectus, and going obliquely inwards, it passes over the vastus internus, and, about the middle of the os femoris, over part of the triceps; it runs down farther between the tendon of the adductor magnus and that of the gracilis muscles.

Inserted, by a broad and thin tendon, into the inner side of the tibia, near the inferior part of its tubercle.

Use. To bend the leg obliquely inwards, or to bring one leg across the other.

2. *Gracilis,*

Arises, by a thin tendon, from the os pubis, near the symphysis of these two bones, soon grows fleshy, and, descending by the inside of the thigh, is

Inserted, tendinous, into the tibia under the sartorius.

Use. To assist the sartorius.

Before are,

* The muscles of the anterior femoral region. 1. The crest of the ilium. 2. Its anterior superior spinous process. 3. The gluteus medius. 4. The tensor vaginæ femoris; its insertion into the fascia lata is shown inferiorly. 5. The sartorius. 6. The rectus. 7. The vastus externus. 8. The vastus internus. 9. The patella. 10. The iliacus internus. 11. The psoas magnus. 12. The pectineus. 13. The adductor longus. 14. Part of the adductor magnus. 15. The gracilis.

1. *Rectus,*

Arises, fleshy, from the inferior anterior spinous process of the os ilium, and tendinous from the dorsum of the ilium, a little above the acetabulum; runs down over the anterior part of the cervix of the os femoris; the fibres not being straight, but running down like the plumage of a feather obliquely outwards and inwards, from a tendon in the middle.

Inserted, tendinous, into the upper part of the patella, from which a thin tendon runs down, on the forepart of this bone, to terminate in a thick strong ligament, which is sent off from the inferior part of the patella, and inserted into the tubercle of the tibia.

Use. To extend the leg, and, in a powerful manner, by the intervention of the patella, like a pulley.

2. *Vastus Externus,*

Arises, broad, tendinous and fleshy, from the root of the trochanter major, and upper part of the linea aspera; its origin being continued from near the insertion of the gluteus minimus, the whole length of the linea aspera, by fleshy fibres which run obliquely forwards to a middle tendon, where they terminate.

Inserted into a large share of the upper part of the patella; and part of it ends in an aponeurosis, which is continued down to the leg, and in its passage is firmly fixed to the head of the tibia.

Use. To extend the leg.

3. *Vastus Internus,*

Arises, tendinous and fleshy, from between the forepart of the os femoris and root of the trochanter minor, and from almost all the inside of the linea aspera, by fibres running obliquely forwards and downwards.

Inserted, tendinous, into the upper and inside of the patella, continuing fleshy lower than the vastus externus. Part of it likewise ends in an aponeurosis continued down to the leg, and fixed in its passage to the upper part of the tibia.

Use. To extend the leg.

4. *Cruralis,*

Arises, fleshy, from between the two trochanters of the os femoris, but nearer the lesser trochanter, and firmly adhering to most of the forepart of the os femoris, and connected to both vasti muscles.

Fig. 100.*

Inserted, tendinous, into the upper part of the patella, behind the rectus.

Use. To assist in the extension of the leg.

N. B. These four muscles *before*, being inserted into the patella, have the same effect upon the leg as if they were immediately inserted into it by means of the strong tendon, or rather ligament which is sent off from the inferior part of the patella to the tibia.

Behind are,

1. *Semitendinosus,*

Arises, tendinous and fleshy, in common with the long head of the biceps, from the posterior part of the tuberosity of the os ischium; and sending down a long roundish tendon, which ends flat, is

Inserted into the inside of the ridge of the tibia, a little below its tubercle.

Use. To bend the leg backwards and a little inwards.

* The muscles of the posterior femoral and gluteal region. 1. The gluteus medius. 2. The gluteus maximus. 3. The vastus externus covered in by fascia lata. 4. The long head of the biceps. 5. Its short head. 6. The semi-tendinosus. 7. The semi-membranosus. 8. The gracilis. 9. A part of the inner border of the adductor magnus. 10. The edge of the sartorius. 11. The popliteal space. 12. The gastrocnemius muscle; its two heads. The tendon of the biceps forms the outer hamstring; and the sartorius with the tendons of the gracilis, semi-tendinosus, and semimembranosus, the inner hamstring.

2. *Semimembranosus,*

Arises, tendinous, from the upper and posterior part of the tuberosity of the os ischium; sends down a broad flat tendon, which ends in a fleshy belly, and, in its descent, runs at first on the forepart of the biceps, and lower, between it and the semitendinosus.

Inserted, tendinous, into the inner and back part of the head of the tibia.

Use. To bend the leg, and bring it directly backward.

N. B. The two last form what is called the *inner hamstring.*

3. *Biceps Flexor Cruris,*

Arises by two distinct heads. The first, called *longus*, arises, in common with the semitendinosus, from the upper and posterior part of the tuberosity of the os ischium. The second, called *brevis*, arises from the linea aspera, a little below the termination of the gluteus maximus, by a fleshy acute beginning, which soon grows broader as it descends to join with the first head, a little above the external condyle of the os femoris.

Inserted, by a strong tendon, into the upper part of the head of the fibula.

Use. To bend the leg.

N. B. This muscle forms what is called the *outer hamstring;* and between it and the inner, the nervus popliteus, the arteria and vena poplitea, are situated.

4. *Popliteus,*

Arises, by a round tendon, from the lower and back part of the external condyle of the os femoris, then runs over the ligament that involves the joint; firmly adhering to it, and part of the semilunar cartilage. As it runs over the joint, it becomes fleshy, and the fibres run obliquely inwards, being covered with a thin tendinous membrane.

Inserted, broad, thin and fleshy, into a ridge at the upper and internal edge of the tibia, a little below its head.

Use. To assist in bending the leg, and to prevent the cap-

sular ligament from being pinched. After the leg is bent, this muscle serves to roll it inwards.

Muscles situated on the Leg.

These muscles may be arranged in the two general classes of flexors and extensors of the foot, and flexors and extensors of the toes; but several of them, viz. the tibialis and the peronei, produce effects which are different from flexion or extension. For the accommodation of the student of anatomy, they may be studied in the order of their position as they lie on the front, on the outside, and on the back of the leg.

Muscles on the Front of the Leg.

1. *Tibialis Anticus.*

Arises, tendinous and fleshy, from the middle of that process of the tibia, to which the fibula is connected above; then it runs down fleshy on the outside of the tibia; from which, and the upper part of the interosseous ligament, it receives a number of distinct fleshy fibres; near the extremity of the tibia, it sends off a strong round tendon, which passes under part of the ligamentum tarsi annulare near the malleolus internus.

Inserted, tendinous, into the inside of the os cuneiforme internum, and posterior end of the metatarsal bone that sustains the great toe.

Use. To bend the foot, by drawing it upwards, and, at the same time, to turn the toes inwards.

2. *Extensor Proprius Pollicis Pedis,*

Arises, by an acute, tendinous, and fleshy beginning, some way below the head and anterior part of the fibula, along which it runs to near its lower extremity, connected to it by a number of fleshy fibres, which descend obliquely towards a tendon.

Inserted, tendinous, into the posterior part of the first and last joint of the great toe.

Use. To extend the great toe.

3. *Extensor Longus Digitorum Pedis,*

Arises, tendinous and fleshy, from the upper and outer part of the head of the tibia, and from the head of the fibula where it joins with the tibia, and from the interosseous ligament; also from the tendinous fascia, which covers the upper and outside of the leg by a number of fleshy fibres; and tendinous and fleshy from the anterior spine of the fibula, almost its whole length, where it is inseparable from the *peroneus tertius.* It splits into four round tendons, under the ligamentum tarsi annulare.

Fig. 101.*

Inserted, by a flat tendon, into the root of the first joint of each of the four small toes; and is expanded over the upper side of the toes, as far as the root of the last joint.

Use. To extend all the joints of the four small toes.

N. B. A portion of this muscle, which is called

4. *Peroneus Tertius,*

Arises, from the middle of the fibula, continues down to near its inferior extremity, and sends its fleshy fibres forwards to a tendon, which passes under the annular ligament, and is

* The muscles of the anterior tibial region. 1. The extensor muscles inserted into the patella. 2. The subcutaneous surface of the tibia. 3. The tibialis anticus. 4. The extensor communis digitorum. 5. The extensor proprius pollicis. 6. The peroneus tertius. 7. The peroneus longus. 8. The peroneus brevis. 9, 9. The borders of the soleus muscle. 10. A part of the inner belly of the gastrocnemius. 11. The extensor brevis digitorum; the tendon in front of this number is that of the peroneus tertius; and that behind it, the tendon of the peroneus brevis.

Inserted, into the root of the metatarsal bone that sustains the little toe.

Use. To assist in bending the foot.

Muscles on the outside of the Leg.

1. *Peroneus Longus.*

Arises, tendinous and fleshy, from the forepart of the head of the peroneus, or fibula, the fibres running straight down; also from the upper and external part of the fibula, where it begins to rise into a round edge; as, also, from the hollow between that and its anterior edge, as far down as to reach within a hand's breadth of the ankle, by a number of fleshy fibres, which run outwards towards a tendon, that subsequently becomes long and round, and passes through a channel at the outer ankle, in the back part of the inferior extremity of the fibula; then being reflected to the sinuosity of the os calcis, it runs along a groove in the os cuboides, above the muscles in the sole of the foot.

Inserted, tendinous, into the outside of the root of the metatarsal bone that sustains the great toe, and by some tendinous fibres into the os cuneiforme internum.

Use. To turn the foot outwards, and to extend it a little.

2. *Peroneus Brevis,*

Arises, by an acute fleshy beginning, from above the middle of the external part of the fibula; from the outer side of the anterior spine of this bone; as also from its round edge externally, the fibres running obliquely outwards towards a tendon on its external side: it sends off a round tendon which passes through the groove at the outer ankle, being there included under the same ligament with that of the preceding muscle; and a little farther, it runs through a particular one of its own.

Inserted, tendinous, into the root and external part of the metatarsal bone that sustains the little toe.

Use. To assist the former in pulling the foot outwards, and extending it a little.

Muscles on the Back of the Leg.

1. *Gastrocnemius Externus*, seu *Gemellus*,

Arises, by two distinct heads. The first head arises from the upper and back part of the internal condyle of the os femoris, and from that bone, a little above its condyle, by two distinct tendinous origins. The second head arises tendinous from the upper and back part of the external condyle of the os femoris. A little below the joint, their fleshy bellies unite in a middle tendon; and, below the middle of the tibia, it sends off a broad thin tendon, which joins a little above the extremity of the tibia with the tendon of the following.

Fig. 102.*

2. *Soleus*, seu *Gastrocnemius Internus*,

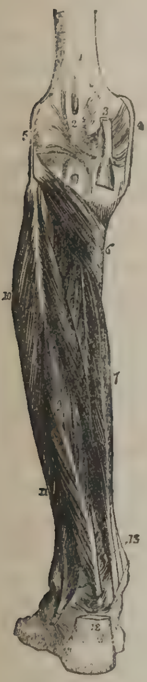
Arises by two origins. The first is from the upper and back part of the head of the fibula, continuing to receive many of its fleshy fibres from the posterior part of that bone for some space below its head. The other origin begins from the posterior and upper part of the middle of the tibia; and runs inwards along the inferior edge of the popliteus towards the inner part of the tibia, from which it receives fleshy fibres for some way down. The flesh of this muscle, covered by the tendon of the gemellus, runs down nearly as far as the extremity of the tibia; a little above which the tendons of

* The superficial muscles on the posterior surface of the leg. 1. Biceps flexor cruris muscle, forming the outer hamstring. 2. The tendons forming the inner hamstring, consisting of the tendons of the semitendinosus, semimembranosus, gracilis and sartorius. 3. The popliteal space. 4. The gastrocnemius muscle. 5, 5. The soleus muscle. 6. Tendo Achillis. 7. The posterior tuberosity of the os calcis. 8. The tendons of the peroneus longus and brevis muscles, passing behind the outer ankle. 9. The tendons of the deep layer of muscles passing into the foot behind the inner ankle.

both gastrocnemii unite, and form a strong round cord, which is called *tendo-Achillis.*

Inserted into the upper and posterior part of the os calcis, by the projection of which the tendo-Achillis is placed at a considerable distance from the tibia.

Fig. 103.



Use. To extend the foot, by bringing it backwards and downwards.

3. *Plantaris.*

Arises, thin and fleshy, from the upper and back part of the root of the external condyle of the os femoris, near the interior extremity of that bone, adhering to the ligament that involves the joint in its descent. It passes along the second origin of the soleus and under the gemellus, where it sends off a long, slender, thin tendon, which comes from between the great extensors, where they join tendons; then runs down by the inside of the tendo-Achillis.

Inserted, into the inside of the posterior part of the os calcis, below the tendo-Achillis.

Use. To assist the former, and to pull the capsular ligament of the knee from between the bones. It seems likewise to assist in rolling the foot forwards.

* The deep layer of muscles of the posterior tibial region. 1. The lower extremity of the femur. 2. The ligamentum posticum Winslowii. 3. The tendon of the semi-membranosus muscle dividing into its three slips. 4. The internal lateral ligament of the knee-joint. 5. The external lateral ligament. 6. The popliteus muscle. 7. The flexor longus digitorum. 8. The tibialis posticus. 9. The flexor longus pollicis. 10. The peroneus longus muscle. 11. The peroneus brevis. 12. The tendo-Achillis divided at its insertion into the os calcis. 13. The tendons of the tibialis posticus and flexor longus digitorum muscles, just as they are about to pass beneath the internal annular ligament of the ankle; the interval between the latter tendon and the tendon of the flexor longus pollicis is occupied by the posterior tibial vessels and nerves.

4. *Flexor Longus Digitorum Pedis, Profundus, Perforans,*

Arises, by an acute tendon, which soon becomes fleshy from the back part of the tibia, some way below its head, near the entry of the medullary artery; which beginning, is continued down the inner edge of this bone by short fleshy fibres, ending in its tendon; also by tendinous and fleshy fibres, from the outer edge of the tibia, and between this double order of fibres, the tibialis posticus muscle lies enclosed. Having passed under two annular ligaments, it then passes through a sinuosity at the inside of the os calcis; and about the middle of the sole of the foot, divides into four tendons, which passes through the slits of the perforatus; and just before its division it receives a considerable tendon from that of the flexor pollicis longus.

Inserted into the extremity of the last joint of the four lesser toes.

Use. To bend the last joint of the toes.

5. *Tibialis Posticus,*

Arises, by a narrow fleshy beginning, from the fore and upper part of the tibia, just under the process which joins it to the fibula; then passing through a perforation in the upper part of the interosseous ligament, it continues its origin from the back part of the fibula next the tibia, and from near one half of the upper part of the last named bone; as also, from the interosseous ligament, the fibres running towards a middle tendon, which sends off a round one that passes in a groove behind the malleolus internus.[1]

Inserted, tendinous, into the upper and inner part of the os naviculare, being farther continued to the os cuneiforme internum and medium; besides it gives some tendinous filaments to the os calcis, os cuboides, and to the root of the metatarsal bone that sustains the middle toe.

Use. To extend the foot, and to turn the toes inwards.

6. *Flexor Longus Pollicis Pedis,*

Arises, by an acute, tendinous, and fleshy beginning, from the posterior part of the fibula, some way below its head, being

continued down the same bone, almost to its inferior extremity, by a double order of oblique fleshy fibres; its tendon passes under an annular ligament at the inner ankle.

Inserted into the last joint of the great toe, and, generally, sends a small tendon to the os calcis.

Use. To bend the last joint of this toe.

On the upper surface of the foot there is one muscle, viz.

Extensor Brevis Digitorum Pedis,

Arises, fleshy and tendinous, from the fore and upper part of the os calcis; and soon forms a fleshy belly, divisible into four portions, which send off an equal number of tendons that pass over the upper part of the foot, under the tendons of the former.

Inserted, by four slender tendons, into the tendinous expansion from the extensor longus which covers the small toes, except the little one; also into the tendinous expansion from the extensor pollicis, that covers the upper part of the great toe.

Use. To extend the toes.

Muscles on the Sole of the Foot.

On the sole of the foot there is a strong tendinous membrane called *Aponeurosis Plantaris*, which originates from the tuberosity of the os calcis, and proceeds forward to the toes, increasing gradually in breadth.

It is divided into three portions. That in the middle is the largest; it protects and covers the short flexor muscles, and the tendons in the middle of the foot. That on the outside, which covers the adductor and flexor of the little toe, is next in size. The internal portion, which covers the adductor of the great toe, is the smallest.

The edges of these portions dip down so as to separate the muscles they cover from each other. They are divided into five processes, corresponding with the heads of the metatarsal bones; each of these portions is divided into two bands, which are inserted into each side of the head of each metatarsal bone, and the tendons, nerves, and arteries pass between them.

Immediately under the middle portion of this aponeurosis are the common short flexors of the toes, viz.

1. *Flexor Brevis Digitorum Pedis Sublimis Perforatus,*

Arises, by a narrow fleshy beginning, from the inferior and posterior part of the protuberance of the os calcis, between the adductors of the great and little toes, soon forms a thick

fleshy belly, which sends off four tendons that split for the passage of the flexor longus.

Fig. 104.*

Inserted into the second phalanx of the four lesser toes. The tendon of the little toe is often wanting.

Use. To bend the second joint of the toes.

2. *Flexor Digitorum Accessorius,* seu, *Massa Carnea Jacobii Sylvii,*

Arises, by a thin fleshy origin, from most part of the sinuosity at the inside of the os calcis, which is continued forwards, for some space on the same bone; also, by a thin tendinous beginning, from before the tuberosity of the os calcis, externally, and, soon becoming all fleshy, is

Inserted into the tendon of the flexor longus, just at its division into four tendons.

Use. To assist the flexor longus.

3. *Lumbricales Pedis,*

Arises, by four tendinous and fleshy beginnings, from the tendon of the flexor profundus, just before its division, near the insertion of the massa carnea.

Inserted, by four slender tendons, into the inside of the first joint of the four lesser toes, and are lost in the tendinous expansion that is sent from the extensors to cover the upper part of the toes.

The first layer of muscles in the sole of the foot: this layer is exposed by the removal of the plantar fascia. 1. The os calcis. 2. The posterior part of the plantar fascia divided transversely. 3. The abductor pollicis. 4 The abductor minimi digiti. 5. The flexor brevis digitorum. 6. The tendon of the flexor longus pollicis muscle. 7, 7. The lumbricales. On the second and third toes, the tendons of the flexor longus digitorum are seen passing through the bifurcation of the tendons of the flexor brevis digitorum.

Use. To increase the flexion of the toes, and to draw them inwards.

On the inside of the foot, and under the common flexors, are the muscles which are considered as exclusively appropriated to the great toe, viz.

1. *Abductor Pollicis Pedis,*

Arises, from the internal side of the tuberosity of the os calcis, and from a ligament which extends from this tuberosity to the sheath of the tendon of the tibialis posticus muscle, and also from the internal and inferior side of the os naviculare and cuneiforme internum. It likewise *arises* from that portion of the aponeurosis plantaris, which separates it from the short flexor of the toes, and many of its fibres appear to be connected with the ligaments which pass from the posterior to the anterior bones of the foot: as it passes under the cuneiform bone, a portion of its lower surface is tendinous.

It is inseparably connected to the flexor of the great toe, and is *inserted* into the internal sesamoid bone, and the inferior and internal part of the root of the first bones of the great toe.

This muscle not only separates the great toe from the other toes, but it must increase the curvature, or arched form of the foot.

2. *Flexor Brevis Pollicis Pedis,*

Arises, tendinous, from the under and forepart of the os calcis, where it joins with the os cuboides, from the os cuneiforme externum, and is inseparably united with the abductor and adductor pollicis.

Inserted into the internal and external sesamoid bones, along with the abductor and adductor pollicis, and into the root of the first joint of the great toe.

Use. To bend the first joint.

3. *Adductor Pollicis Pedis,*

Arises, by a long thin tendon, from the os calcis, from the os cuboides, from the os cuneiforme externum, and from the root of the metatarsal bone of the second toe.

Fig. 105.*

Inserted into the external os sesamoideum, and root of the metatarsal bone of the great toe.

Use. To bring this toe nearer the rest.

Near the outer edge of the foot, under the second portion of the aponeurosis plantaris, are the muscles peculiar to the little toe, viz.

1. *Adductor Minimi Digiti Pedis,*

Arises, tendinous and fleshy, from the semicircular edge of a cavity on the inferior part of the protuberance of the os calcis, and from the root of the metatarsal bone of the little toe.

Inserted into the root of the first joint of the little toe externally.

Use. To draw the little toe outwards from the rest, and assist in preserving the arched form of the foot.

2. *Flexor Brevis Minimi Digiti Pedis,*

Arises, tendinous, from the os cuboides, near the sulcus or furrow for lodging the tendon of the peroneus longus; fleshy from the outside of the metatarsal bone that sustains the little toe, below its protuberant part.

Inserted, into the anterior extremity of the metatarsal bone, and root of the first joint of this toe.

Use. To bend this toe.

* The third and a part of the second layer of muscles of the sole of the foot. 1. The divided edge of the plantar fascia. 2. The musculus accessorius. 3. The tendon of the flexor longus digitorum, previously to its division. 4. The tendon of the flexor longus pollicis. 5. The flexor brevis pollicis. 6. The adductor pollicis. 7. The flexor brevis minimi digiti. 8. The transversus pedis. 9. Interossei muscles, plantar and dorsal. 10. A convex ridge formed by the tendon of the peroneus longus muscle in its oblique course across the foot.

Between the metatarsal bones are four external and three internal interossei: and one muscle which is common to all the metatarsal bones.

Interossei Pedis Externi, Bicipites.

1. *Abductor Indicis Pedis,*

Arises, tendinous and fleshy, by two origins, from the root of the inside of the metatarsal bone of the fore toe, from the outside of the root of the metatarsal bone of the great toe, and from the os cuneiforme internum.

Inserted, tendinous, into the inside of the root of the first joint of the fore toe.

Use. To pull the fore toe inwards from the rest of the small toes.

2. *Adductor Indicis Pedis,*

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the fore and second toe.

Inserted, tendinous, into the outside of the root of the first joint of the fore toe.

Use. To pull the fore toe outwards towards the rest.

3. *Adductor Medii Digiti Pedis,*

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the second and third toes.

Inserted, tendinous, into the outside of the root of the first joint of the second toe.

Use. To pull the second toe outwards.

4. *Adductor Tertii Digiti Pedis,*

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the third and little toe.

Inserted, tendinous, into the outside of the root of the first joint of the third toe.

Use. To pull the third toe outwards.

Interossei Pedis Interni,

1. *Abductor Medii Digiti Pedis,*

Arises, tendinous and fleshy, from the inside of the root of the metatarsal bone of the middle toe internally.

Inserted, tendinous, into the inside of the root of the first joint of the middle toe.

Use. To pull the middle toe inwards.

2. *Abductor Tertii Digiti Pedis,*

Arises, tendinous and fleshy, from the inside and inferior part of the root of the metatarsal bone of the third toe.

Inserted, tendinous, into the inside of the root of the first joint of the third toe.

Use. To pull the third toe inwards.

3. *Abductor Minimi Digiti Pedis,*

Arises, tendinous and fleshy, from the inside of the root of the metatarsal bone of the little toe.

Inserted, tendinous, into the inside of the root of the first joint of the little toe.

Use. To pull the little toe inwards.

The common muscle,

Transversalis Pedis,

Arises, tendinous, from the under part of the anterior extremity of the metatarsal bone of the great toe, and from the internal os sesamoideum of the first joint, adhering to the adductor pollicis.

Inserted, tendinous, into the under and outer part of the anterior extremity of the metatarsal bone of the little toe, and ligament of the next toe.

Use, to contract the foot, by bringing the great toe and the two outermost toes nearer each other.

CHAPTER IX.

OBSERVATIONS ON THE MOTIONS OF THE SKELETON.

THE falling down of the body during life, when muscular action is suspended, as well as the examination of the artificial skeleton, evince that this machine is not constructed to preserve the erect position of itself; but that, when unsupported, it bends at the joints, and invariably falls forward.

It is retained in the erect position by the action of muscles: and that the muscles should produce this effect, it is necessary that they should have a fixed basis to act from.

This basis is the feet, and they are fixed to the ground by the weight of the body.

To keep the body from falling, it is necessary that the centre of gravity should be immediately over the centre of the common basis.

All our movements, both in walking, standing, and rising from our seats, are regulated by this principle; and whenever we move our body, so that the centre of gravity is changed, we must change the position of the feet, that the centre of the basis may be directly under it.

If this proposition were not almost self-evident, it might be illustrated by several very easy experiments.

If a person stand against a wall with his heels and the back parts of his legs and thighs in contact with it, and, in this situation, attempts to stoop forward, he will fall upon his face; there is no power in his muscles, or in any other part of the body, when thus circumstanced, to prevent it; but a small movement forward of one foot, will enable him to stoop with ease by altering the basis of the body.

When we sit in such a position that we cannot bring the centre of gravity over the feet, the lower limbs are divested of

all power of elevating the body: this is always the case when we sit with the thighs and legs at right angles with each other. Bend the knees to an acute angle, so that the feet are placed under the body, and we rise with ease.

When we wish to stoop forward without advancing one of our feet, we acquire the power in a small degree, by placing our hands behind us, to preserve the equilibrium.

Some old persons, whose spines curve forwards in consequence of age, bend their lower limbs, so that the pelvis may be projected backwards beyond the centre of the base of the body, and form a counterpoise to the upper part of the trunk.

Bending the knees alone, without projecting the pelvis backwards, will not produce this effect; for a person who stands with his back to a wall will bend his knees without obtaining this advantage, while the heels and back part of the pelvis are in contact with the wall.

When we stand with the toes pointing directly forwards, the base of the body is a square; of which the feet are two of the sides. As the positions of the feet are changed, the figure of the base and its centre necessarily change also. When the feet are placed one immediately before the other, the centre is between the toes of the one and the heel of the other. When the position of the feet is such, that the toes point directly outwards, and the heels are opposite to each other, the centre of the base is between the heels.

In these cases, when the situation of the centre of the base is changed, we immediately change the centre of gravity. Thus, as we turn the toes outwards, the centre of the base moves backwards, we, therefore, immediately make the body more erect; and by that means keep the centre of gravity over the centre of the base.

We move the centre of gravity laterally, as well as backwards and forwards, in conformity to this principle.

Thus, when we raise one foot from the ground, the body inclines so much in the opposite direction, that the centre of gravity is directly over the other. If the spine is diseased in one spot, and assumes a lateral curvature, placing the centre of

gravity on one side of the natural centre of the base; another curve is formed by muscular action, in a sound part of the spine, to counteract the first, and keep the centre of gravity in its natural position.

The perception of a tendency to fall, when the centre of gravity is in a wrong situation, first induces us to make efforts to resist this tendency; we learn by experience what these efforts ought to be: and by habit we at length make them without consciousness.

As the natural tendency of the skeleton, when we stand, is to bend at the articulations, and, therefore, to fall forwards; the muscles which have the principal effort in keeping the body erect, must be the extensors.

Thus, the muscles on the back of the leg, and particularly the soleus, keep the tibia erect: while the muscles on the front of the thigh, the vasti and crureus, produce the same effect upon the os femoris: the bones being kept steady by the occasional counteraction of the antagonist muscles.

The whole lower limb is thus made erect by an exertion which begins at the foot, while the foot is fixed to the ground by the weight and pressure of the body above it.

The trunk of the body has a strong tendency to bend forward at the articulations of the thigh bones and the ossa innominata. This tendency is resisted by the muscles which lie on the back part of the ossa femoris, and extend the trunk on those bones, viz. the *glutei maximi.*

The muscles which arise from the tuberosity of the ischium, and are inserted into the leg, the semitendinosus, semimembranosus, and the long head of the biceps flexor cruris, have also this effect.

The flexure of the thoracic and lumbar portions of the spine is counteracted by the sacro-lumbalis, and longissimus dorsi, which act from the sacrum and back parts of the pelvis. The *yellow ligaments,* which are *elastic,* must also co-operate to this effect: so that with regard to the spine, there is an additional agent distinct from the muscular power.

Indeed, respecting the vertebral articulations in general, it

may be observed, that the connexion of the bodies of the vertebræ, by the intervertebral cartilaginous matter, and of the plates behind, by the elastic ligament, renders these articulations perfectly anomalous; and very different in their principles from the articulations in general.

In no part of the skeleton is this tendency to bend forward more strongly perceived than in the head. When we are awake, and the muscles in a healthy situation, it is effectually restrained, and the head kept erect, by the splenius and complexus, and other muscles, which act from the spine below, upon the back part of the head and the vertebræ of the neck.

When we stand on one foot, some very different muscles are called into action; the tendency of the body is to fall sideways, towards the foot which is raised from the ground. To counteract this tendency the two larger peronei muscles, which are situated on the outside of the leg, act from the foot, to keep the leg erect. The vastus externus acts upon the same principle from the leg upon the os femoris. The gluteus medius and minimus, and the muscle of the fascia, act from the os femoris upon the pelvis and trunk; while the quadratus lumborum, and those abdominal muscles which draw the spine to that side, continue the operation: and so do likewise the muscles which act on the same side of the neck and head.

In rising from a seat, the tibialis anticus acts very powerfully, to keep the tibia erect, and prevent it from inclining backwards. The two vasti, and the cruræus, raise up the os femoris, while the gluteus maximus, the semitendinosus, and semimembranosus, and the long head of the biceps, extend the trunk of the body.

There are several modes of *walking*, which are different from each other, in a small degree.

We may walk, for example, with the knee of the hind limb straight or bent, as we bring it forward. This circumstance is merely a matter of accommodation. But there are two essential processes in walking, viz. 1. Projecting one foot forward, and placing it on the ground while thus projected: and 2. Moving the body over that foot.

The mode of projecting the foot requires no explanation; but the manner of bringing it to the ground, when thus advanced ought to be noticed.

If, after standing with both feet on the same line, we move one foot forwards, suppose the right foot, it cannot be applied flat to the ground, unless we either incline the body forward or move the pelvis on the left thigh, so that the right side may present obliquely forward; or lower the right side of the pelvis, so that it may be nearer the ground.

When we incline the body forward, and thus bring the right foot to the ground, we perform the second essential process in walking, along with the first: for we move the body over the fore foot. The muscles on the front part of the hind leg, and particularly the tibialis anticus, seem to produce this effect, by bending, or inclining forward, the tibia on the foot.

When the foot is brought to the ground by a rotation of the pelvis, it is likewise the tibialis anticus, and the muscles on the front of the hind leg, that move the body over it, or that begin the motion.

The gastrocnemius and soleus, and the flexors of the toes, particularly that of the great toe, occasionally co-operate with great effect. By raising the heel, and thus lengthening the hind limb, they push the body forward, and continue its motion in that direction after the effect of the tibialis anticus ceases. The length of the step appears, therefore, to require this elevation of the heel, and depression of the toes; but it should be observed, that when we take long steps, we also turn the pelvis partly round, presenting the side obliquely forward; and in this manner increase the anterior projection of the front leg.

Although the action of the gastrocnemius, &c., seems necessary to walking with long steps, we can walk without their operation. This is proved incontestably by the act of walking on the heel: when the gastrocnemii and the flexors are so far from acting, that they are in a state of extension. In this operation, the principal effort seems to be made by the tibialis anticus, and the muscles on the front of the leg; and the extensor muscles on the front of the thigh.

Notwithstanding these facts, the action of the gastrocnemius and soleus is essential whenever we raise the heel from the ground, while the weight of the body presses on the front part of the foot; and it then acts with a force which equals, if it does not exceed, the weight of the body.

Jumping, at the first view of it, appears an extraordinary operation; but if a man who lies on the ground, with his feet against a wall, makes a muscular exertion, such as is necessary for jumping, the nature of the operation is very intelligible. It is a sudden *extension* of the feet and knees, and sometimes of the trunk of the body. The stroke is made against the wall; but as that does not yield, the whole motion is impressed upon the body; which is projected from the wall horizontally in the same way that in jumping, it is projected from the ground vertically.

PART IV.

OF THE GENERAL INTEGUMENTS, OR OF THE CELLULAR MEMBRANE, AND THE SKIN.*

CHAPTER X.

OF THE CELLULAR MEMBRANE.

That substance which is situated between the skin and the muscles, which is insinuated between the different muscles, and between the fibres which compose them; which also connects the different parts of the body to each other, is denominated the *Cellular Membrane*, or *Tela Cellulosa.*

As it extends over the whole of the body, and is most intimately connected with the skin, it is considered as one of the integuments, although it is found in great quantities in some of the internal parts.

* The integuments of the body consist of the skin or dermoid tissue, and of that portion of the common cellular tissue which is subcutaneous, and seems to connect the skin, to the subjacent parts. The cellular tissue is loose and elastic, and by this simple arrangement, the skin is loosely connected to the muscles, and not forced to follow them rigidly in their contractions; thus, the roundness of the surface and the smoothness of the skin, is in a great measure preserved. The skin is directly continuous in the mouth, nares, urethra, vagina, anus, and external auditory meatus, with the mucous membranes lining the interior of all the cavities of the body. The continuation or conversion of one into the other at these orifices, is so gradual as to be almost insensible, as will be more carefully shown under the head of mucous membrane. For this reason, by many of the French anatomists, the skin is called the *external tegumentary membrane*, and the mucous membrane the *internal tegumentary membrane*. The basis or derma of the two tissues being considered with some modification the same, the cuticle analogous to the undried mucous of the latter membrane, the papilli and sebaceous glands of the skin, to the villi and follicles of the latter membrane.

This division into two membranes is not new; it may be traced to the time of Galen, but we are indebted for its re-introduction to science, principally to Bonn, and Bichat. The physiological and morbid sympathies of the two membranes have been long known, as being more intimate, than that which exists between any two thoroughly distinct tissues in the human body.—P.

It appears to be composed of membranous laminæ, exquisitely fine and delicate in their structure, which are so connected to each other that they compose cells or cavities of various forms and sizes.

When these cavities are empty, this arrangement of the cellular membrane is not apparent; but when they are distended by water or air it is very evident.

The laminæ which pass from one contiguous part to another are of different lengths, according to the motions performed by the different parts; thus, about the muscles and their tendons they are of considerable length, and between the coats of the eye they are very short.

In some places, these laminæ are compressed together, and form a dense membrane somewhat resembling tendon; but whenever they are separated from each other, they appear pellucid, and extremely delicate.

The term *cell* and *cellgerm* being used by the latest writers on anatomy in a very definite and restricted sense, the name cellular tissue seems to be almost improper for a structure which is ultimately composed of filaments, intricately interwoven, but forming open spaces, and perfectly permeable as shown by the easy transgress of fluids from one part of the body to another. By cell is meant, a closed vesicle, containing a nucleus, whose walls and contents may undergo various changes by the processes of endosmosis and exosmosis, or which may remain as a cell in the constitution of different tissues. These cells are the primary offspring of the cellgerm, or cytoblast (a nucleus including a nucleolus) being analogous to the blood globules or corpuscles which possess the faculty of producing their like, out of the surrounding amorphous fluid or cytoblastema ; the vital fluids containing the elements of all organic formation. Out of such a cell-mass, all the organs in the embryo are developed, and we may still observe similar transformations, in the processes of reproduction of the different organs. Cells, as such, compose the simpler extra-vascular tissues, as the adipose and pigmentary cells, the horny tissue with its various modifications in the epidermis, hair, nails, horns, claws, hoofs, and the epithelium. In

cartilage and bone a cellular structure also is visible as has been shown already. By their transformation into solid or hollow fibres, lamellæ and membranes, these cells become the foundation of all the other tissues. When cells pass into fibres, they first become elongated, and generally in both directions; their walls, probably strengthened by the cytoblastema adhering around them, become contiguous, stretch themselves farther, and thus form connecting fibres between the several nuclei; these after having become granular, are resolved and disappear altogether, and by interlacings the fibrous structure is achieved. Out of such cellular fibres, the cellular tissue is composed; they are extremely fine and transparent, soft but tough, and appear somewhat contractile, particularly in the subcutaneous cellular tissue, which contain besides the serous fluid and fat belonging to it, numerous vessels and nerves, and may be called a main laboratory of the animal chemistry. The investing and uniting cellular tissue is somewhat firmer; this covers the surface of most single organs and their constituent parts. Cellular substance enters also into the composition of the parenchyma of the organs, whose constituent parts it at the same time unites and isolates.

—The cellular tissue serves as the connecting medium of other tissues, and might very properly be called the *connecting tissue.* In the fœtus, when all the parts are soft, and as yet unformed, it presents the aspect of mucus, filling up the interstices of the other nascent organs. Hence Bordeu and Meckel, have denominated it the *mucous tissue,* and supposed that its cellular and membranous structure, was produced mechanically by the traction of surrounding air, or the infiltration of fluid. The term *mucous,* however, is inappropriate and confusing, and applicable only to the embryonic state of the organ; it has been proved by microscopical investigations to be erroneous when the developement of the tissue is complete.

—The ultimate elements of all cellular tissue are fibres, not merely globules or lamellæ. These primary fibres are among the most minute constituent elements of the human body. Their diameter, according to the microscopical measurements

of Jordan, is the $\frac{1}{1450}$th part of an English line. They are transparent, and yield gelatine on boiling, in which respect they correspond with the primitive fibres of tendons. Treviranus has recently asserted from microscopical observations, that they are hollow cylinders, which terminate by one extremity in the minute lymphatic vessels.* This, which possibly may be the case, and is supported by the opinion of Fohman, wants confirmation from other observers.†

—These fibres of the cellular tissue, are united so as to form lamellated membranes which cross each other in all directions, and produce an irregular interlacement, constituting a series of cells, which communicate together. The tissue thus formed, might with propriety be called arealor or filamentous. It is of a greyish aspect and highly elastic. This latter property does not appear to depend upon any innate elasticity in the ultimate filaments, but on the sinuous disposition of these filaments, and of the fasciculi into which they are collected. It is continuous over the whole body; hence the great extent to which it may be affected by diffuse inflammation.

—In many parts of the body, as in the axilla, under the subscapularis muscle, and between the free surfaces of muscles and their sheaths the cellular tissue is very loose and extensible.

—In other situations it is much more condensed and firm, as in the submucous, subserous, and subcutaneous cellular tissues.

—In the latter of these, which constitutes the superficial fascia, and also in the cutis itself, it approaches to the fibrous tissues, both in density, and in the mode of arrangement of its elementary filaments, and is therefore not unfrequently named fibro-cellular tissue.

These laminæ, when in a healthy state, appear to have no sensibility; but so many nerves pass through them, that pain is generally felt when incisions are made in the cellular membrane.

No vessels can be seen in their composition when they are

* Müller's Archives for 1834, p. 410.

† Vide Breschet, sur le Systeme Lymphatique, etc. Paris, 1836.

free from disease, although many pass through them. On this account they have been considered by some very respectable physiologists as inorganic; but there are good reasons for regarding this sentiment as erroneous.

If a portion of cellular membrane, in the living subject, be brought into view by a surgical operation or a wound, and be allowed to remain some time covered by an emolient cataplasm, or a soft plaster, a complete change of colour will gradually take place; it will become uniformly red, in consequence of the great number of minute vessels into which blood has penetrated during inflammation; and granulations will form on its surface.

These vessels must have existed previously in the sound state of the membrane, and conveyed a transparent fluid; although no structure of this kind was visible. This single fact therefore proves completely its organization.

In some parts of the body, this cellular membrane appears to be moistened by a small quantity of fluid, or halitus, in its cells; which seems merely sufficient to keep it soft and flexible. In other places it is loaded with fat.

There is great reason to believe that the fat is contained in cavities which are somewhat different from the ordinary cavities of the cellular membrane.

The cells or cavities which contain the moisture or halitus communicate with each other, over the whole body. Thus, air insinuated into the cellular membrane exterior to the pleura, in consequence of a fractured rib, will be diffused over the whole body; and produce the disease called *emphysema*. In a patient who is affected with that species of dropsy called *anasarca*, a portion of the fluid will be effused in the head and upper parts of the body, after he has passed a night in bed in a horizontal position; but after he has been in an erect position for some time, the fluid will be accumulated in the legs and feet, or most depending parts of the body, in consequence of its gravity.

It is well known in dissecting-rooms, that the effused water

may be completely discharged from anasarcous subjects, by making incisions in the feet and placing the subject erect.

Blood effused in the cellular membrane is sometimes dispersed in the same way; an ecchymosis often appears in the eyelids in consequence of a contusion on the upper part of the head; and similar appearances occur in almost every part of the body, in consequence of effusion of blood at a distance from them.

The fat or adipose matter is not diffused in this manner: wherever it is first diffused, it remains, uninfluenced by gravity, or the ordinary pressure.

Fat is not observed in every part of the body; it is never seen in the cellular membrane of the eyelids; of the penis; of the lungs; of the parts within the cranium; as well as of several other places. The inconvenience which would result from the accumulation of fat in these places is very obvious: and it is equally certain that the cellular membrane in them must be different from that in which fat is produced.

From these peculiar circumstances, relative to the adeps, it has been inferred, that there was a peculiar apparatus for the production and retension of fat, superadded to the cellular membrane; and some anatomists, with a view to precision, have called the part containing fat, *Adipose Membrane*, and the other part *Reticular Membrane.** They state that in dropsical subjects, who are much emaciated, the membrane which in a healthy state contained adeps, is more ligamentous than the ordinary cellular membrane.

It seems to be proved, by reasoning, that there must be a considerable difference between these different parts of the cellular membrane: but it ought to be observed that those parts of the omentum which are especially appropriated to the production of adeps, do not exhibit any peculiarity of structure.

This adipose substance is distributed in unequal proportions in different parts of the body. In corpulent persons there is a

* See remarks on the cellular membrane, &c., by Dr. W. Hunter, in the London Medical Observations and Inquiries, vol. ii.

considerable quantity of it, immediately under the skin, and especially under the skin of the abdomen.

It is also between the muscles, in the orbits of the eyes; in the omentum and mesentery; in the joints and the bones; as well as about the kidneys, and heart also, in elderly persons. In the fœtus, and for some time after birth, it appears to be confined to the parts immediately under the skin, but it soon becomes more diffused. —The fat in the adipose tissue, is unorganized, and at the common temperature of the human body, is almost fluid. On the latter account it produces the softness and smoothness of the exterior, particularly obvious in obese individuals. Its use, probably, besides contributing to the roundness and softness of the exterior, is in part to protect the body against the extremities of heat and cold, in consequence of its being a bad conductor of caloric. It may be considered also, as a deposit of nutriment held in reserve, to be dissolved and taken up again by the absorbents, during fasting, or when any wasting disease has impaired the functions of nutrition. Adipose tissue, belongs to the most simple structures of the body. It differs from cellular tissue even to the knife and eye, by the toughness and courseness of its web, and consists of completely closed membranous cells including the more or less fluid fatty matter. They are affixed according to Mescagni, each one to an artery and vein, the trunks of which are distributed around the cell, and by which the fat is deposited. The fat after being deposited in the cells becomes more consistent by absorption; it is kept moist by a serous secretion from the walls of the cell, which effectually prevents its transudation into the neighbouring tissues. If the fat be reabsorbed, the cells which have no communication with each other, collapse and vanish. The diameter of these vesicles or cells, in man, vary from $\frac{1}{100}$ to $\frac{1}{20}$ of a line; in some places as in the spinal marrow, they are still smaller from the $\frac{1}{200}$ to $\frac{1}{150}$ part of a line. In our larger domestic animals, they are of much coarser structure.—

It is observed by dissectors that there are no subjects, how-

ever emaciated, who are entirely free from fat; except those who have been affected with anasarca.

The cellular membrane has been already observed to form granulations very promptly; and it has been asserted that the granulations, which arise from all the different parts of the body when wounded, originate from the cellular membrane in those parts.

Whether this proposition be true or not, to the extent above stated, it is a fact that granulations, in some instances, seem to have a cellular structure; as the following case will prove.

A patient, with a compound fracture of the leg, which was attended with a large wound, covered with luxuriant granulations, was attacked with an œdematous swelling of the limb, which increased suddenly to a great degree. While this was going on, the granulations on the surface of the wound tumefied with the limb; and, upon examination, appeared somewhat pellucid, with an effused fluid indenting by pressure, precisely as the skin was indented.

The cellular membrane appears to have a most intimate connexion with the skin; and cannot be completely separated from it by dissection. It is said that in certain cases of disease where it is reduced to a slough, while the texture of the skin remains unchanged, as in some species of anthrax or carbuncle, this separation may be completely effected. In such cases the under surface of the skin will appear to be composed of pits or excavations, which penetrate very deep into its substance, and which were occupied by the cellular or adipose membrane while it was in its natural condition.

CHAPTER XI.

OF THE SKIN.

The skin is composed of three dissimilar lamina, which are denominated the *Cutis Vera*, the *Rete Mucosum*, and the *Cuticula*.

Of the Cutis Vera.

THE innermost of the above-mentioned lamina is much more substantial than the others, and therefore is called *Cutis Vera*.

It is an elastic, dense, and strong membrane; which contains in its texture a large proportion of fibres that appear to be tendinous, and are woven together in an intricate manner.*

Blended with these fibres is an immense number of vessels which enter into the texture of the skin; these vessels do not generally convey red blood, and therefore they are not very visible; yet they may be readily brought into view, by the application of rubefacients during life; and by fine injections, in the dead subject. Their existence is also demonstrated in the vigorous infant, at birth, by the universal redness of the skin, which is observable at that time.

Nerves are also distributed to every part of the skin. They can be traced to it very easily; and as there is no part of the skin into which the finest needle can be pushed without pain, it is certain that their distribution must extend to every part.

It is highly probable that the processes of absorption and exhalation are effected by small vessels which originate or terminate on the surface of the skin, and of course form a part of its texture.

The skin, thus constructed, extends over the whole of the

* These fibres hold a middle station between ligamentous and common cellular tissue, and are supposed to consist of the latter in a very compacted state. The meshes, which they leave when woven together, allow of the introduction of vessels and nerves to the papillæ and to the outer surfaces of the cutis vera.—P.

body, and is continued into those cavities which open upon the surface, as the mouth, nose, &c., although its texture changes immediately upon its reflection.

It varies in thickness in different parts; thus, it is thicker on the back than the front of the body. It is thin on the insides of the arms and leg, where opposite surfaces touch each other.*

It is, in general, thinner in women than in men.

The elasticity of the skin is made evident by its yielding to distention, and returning to its usual size; as in pregnancy, dropsy, &c.; but it is particularly demonstrated in some cases of parturition, when the skin of the perinæum stretches immensely, and, after labour, very quickly recovers its size.

The external surface of the skin is very generally divided by superficial grooves or sulci, into small spaces of various angular forms; most commonly rhomboidal. On the palms of the hands and soles of the feet, instead of these figures, we perceive the whole surface composed of furrows and ridges, which, in some places, are rectilineal, and, in others, oval and spiral.

There are also a number of depressions or grooves which seem formed to accommodate the various articulations, particularly about the fingers and toes.

There are other furrows, occasioned by muscles, as those on the forehead: and some depend on the subjacent cellular membrane.

On the external surface of the true skin, when the two exterior laminæ are removed, many papillæ are to be seen. They differ in size in different parts of the body; they are vascular, and, on the ends of the fingers, appear like villi, when examined by a magnifying glass.

There are many perforations or pores to be seen on the skin with the naked eye, which are probably the ducts of sebaceous glands, and the passages which transmit hairs. Other pores, different from either of these, are to be seen when magnifying glasses are used; as those on the fingers; these probably are

* The thickness on the back, is about double what it is on the front of the body.—P.

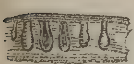
the exhaling or absorbing pores, but their connexion with the vessels which perform these functions has not yet been demonstrated.

The internal surface of the skin, when carefully dissected from the subjacent cellular membrane, in a subject of ordinary corpulency, appears to have some adipose substance in its texture; but, as has been already mentioned, when the cellular membrane is destroyed, these portions of adipose matter disappear, and the surface of the skin appears pitted. It is probable that this connexion of the cellular membrane and skin may occasion that delicacy of skin which appears in some hydropic patients.

In some places on the under surface of the skin are small glands called *miliary*, from their resemblance to the millet seed; these glands are supposed to secrete a sebaceous matter, but they are not so general as has been supposed.

They are sebaceous follicles or ducts, which open on the external surface of the skin, and contain an oily substance, which, sometimes, has the consistence of suet or tallow; when these ducts are filled with sebaceous matter, their orifices are often covered by a black substance, which accidentally adheres to the surface of the matter, and forms very small black spots in the skin. These often occur on the nose and ears, and may be removed by pressing out the sebaceous substance, which rises up in the form of small worms. Sometimes this secretion accumulates in the ducts in such quantities, that it forms small tumours in the skin.

Fig. 106.



—Fig. 106, is a portion of skin cut vertically from the nose of an old man, in order to show the sebaceous follicles and their ducts, which are magnified much beyond their natural size. They are found in all parts of the body, with the exception of the palms of the hands and soles of the feet; but in many parts only become visible to the naked eye, in diseased conditions of the skin. They are most numerous in the face, behind the ears, and in the arm-pits and groin. There is a strong analogy between them and the follicles of mucous membranes.

Fig. 107.

—Fig. 107, represents the orifices of the sebaceous glands, as they are seen in the nose, after it has been deprived of its epidermis. Each follicle consists of a simple depression or doubling inwards of the cutis vera, which becomes more vascular and thin where it forms the walls of the follicle. The sebaceous follicles, according to E. Weber, are much larger than and entirely distinct from those forming the bulbs of the hairs. The latter, too, are situated more deeply, being often found in the subcutaneous cellular tissue. They differ also, according to him, in their structure; each sebaceous follicle being composed of four or five compartments or cells agglomerated together. They are also larger than those of the bulbs of the hairs; the largest diameter of a sebaceous gland, (the transverse,) observed by Dr. Weber, was three-fourths of a line.—

Muscular fibres have been supposed by some persons to exist in the skin, but such fibres have never been demonstrated in it. The skin of the scrotum is often much contracted, but the fibres which produce this effect are very visible in the cellular membrane, and have a muscular appearance.

Although the skin is not muscular, it sometimes changes its appearance in a surprising manner.

When the surface of the body is suddenly exposed to cold, or when the chill of fever exists to a considerable degree, the skin will contract very sensibly, and, at the same time, a great number of conical papillæ will project from its surface. This constitutes the *Cutis Anserini;* and is supposed to be produced by a sudden contraction of the vessels in the skin, which forces out their contents, and of course, diminishes its bulk; while the papillæ do not contract in the same degree, and, therefore, are somewhat projected. Vide, article, *contractile tissue.*

When the skin is free from disease, the two exterior laminæ,

(Cuticula and Rete Mucosum,) may be separated from it completely, after maceration or putrefaction, and the surface will appear smooth; but, in an inflamed skin, a net-work of vessels has been injected, which is considered, by Mr. Cruikshank,* as an additional lamen. In this lamen, the pustules of small-pox originate. When the skin is injected, they appear to be formed at first by very small vessels, arranged in a radiated manner, with a white uninjected substance in the centre, which is supposed to be a slough, occasioned by the irritation of the variolous matter. Mr. Cruikshank, after removing this lamella, was able, by continued maceration of the same skin, to separate another, which was also vascular. It is to be observed that this skin had been preserved for some time in spirits, and was macerated in putrid water a week during the heat of summer, before the first lamella was removed.

The colour of the healthy skin is invariably white, when all the lamellæ exterior to it are removed. This is the case not only with the European, but with the blackest African, and the people of all the intermediate colours.

The variety of colours in the human species depends upon the lamella next to the cutis, which is now to be described.

Of the Rete Mucosum.

Immediately in contact with the external surface of the cutis vera is a thin stratum, of a pulpy or mucilaginous consistence, which appears to be spread uniformly over it, but cannot be detached without deranging its own texture.†

It can be best examined after the cuticle is raised in a blister. In this case it appears like a pulpy substance, spread upon a membrane of a soft and delicate texture. This is the *Rete* or *Corpus Mucosum.*

In this pulpy substance resides the pigmentum or colouring matter, which gives the peculiar complexion to the different races of men. The cutis vera is white, and the cuticle is nearly transparent in them all; but this substance is black in the negro;

* See Experiment on Insensible Perspiration, &c. by W. Cruikshank.

† It has been asserted that the rete mucosum of the scrotum can sometimes be exhibited in a separate state.

copper-coloured, yellow, or tawny, in many of the Asiatics; and yellow, with a tincture of red, in the aborigines of America; while it is transparent, or whitish, in the people of Europe and their descendants.

It can therefore be best examined in the negroes; and if it be inspected immediately after the cuticle of a blister is removed, it will appear as above described, with a black matter diffused through it.

The particular structure of this substance has not been ascertained, although anatomists have paid a good deal of attention to it. It is generally believed by them that no vessels can be injected in it; but Dr. Baynham of Virginia, while he was engaged in anatomical pursuits in London, made a preparation which excited the attention of the British anatomists, on account of its particular relation to this subject.

He injected one of the lower extremities, the *os femoris* of which was diseased with an exostosis; and with a view to an examination of the lamina of the skin, he removed a portion of it from the leg; and after immersing it a few seconds in boiling water, to thicken the lamina, he macerated it in cold water for some days. Upon separating the cuticle, after this treatment, he discovered a texture of vessels on the surface of the cutis vera, which was distinct from the cutis itself. This has often been mentioned as injection of the rete mucosum.

It is to be regretted that Dr. Baynham, who is particularly qualified to decide, has not published his opinion on the subject. Mr. Cruikshank, to whom he afforded the most satisfactory opportunity of examining his preparation, believes that the aforesaid vessels were not a part of the rete mucosum; but that the rete mucosum was to be seen on the epidermis, (being raised with it when it was separated from the cutis,) while this texture remained on the surface of the cutis. He considers these vessels as belonging to the additional lamellæ already mentioned, of which he says Dr. Baynham is the discoverer.

There is therefore every reason to believe that there is a texture of vessels, either in the rete mucosum, or between the cutis vera and the rete mucosum.

After putrefaction, or maceration for a long time, the cuticle separates readily from the cutis vera; and the rete mucosum sometimes adheres to the skin, and sometimes to the cuticle. If the parts are much softened by putrefaction, the rete mucosum can be washed away, like the pigmentum nigrum of the eye; leaving the cutis white, and the cuticle nearly transparent.

In the negroes the black colour of the rete mucosum is greatly diminished, on the palms of the hands, and soles of the feet, and under the nails; but it is perceptible. It is said that the black colour does not appear in the cicatrices of the blacks. This is the fact with respect to recent cicatrices; but those of long standing are often dark-coloured, although not so black as the original skin. The pits of the small-pox in their skins, although white at first, become finally as dark as the original surface.

In Europeans and their descendants the colour of the rete mucosum becomes darker, as they are more exposed to the air and the rays of the sun; and soon changes again to its original fairness, by confinement to the house.

In negroes the skin loses some of its deep glossy black colour during the winter season of cold climates, and recovers it again in summer.

The rete mucosum sometimes undergoes very important changes; there have been several instances in the United States, where large portions of the skin of the African have changed from black to white; owing probably to an absorption of the black pigment from the rete mucosum; or, perhaps, to an absorption of the rete mucosum itself.

There is now in Philadelphia a female, between thirty and forty years of age, in whom this process is going on. One of her parents was a negro and the other a mulatto; and her original complexion accorded with her origin. But a change of colour began during her childhood, in small spots, which have gradually increased so much, that at this time the whole of her body and limbs are nearly white, with the exception of her hands and feet. A large proportion of her face is also white,

and the remainder of it much lighter than it was originally. At this time, some part of her face has an unnatural whiteness; but the skin of her forearms appears like that of a European in a perfectly healthy state. This change of colour is attended with no unusual sensation ; so that if she did not see the alteration, she would not suspect that her skin was any way different now from what it had originally been. She does not appear sensible that the white parts are more susceptible of irritation from the rays of the sun than they were originally ; but they are so much covered by her dress that the experiment has not yet been fairly made.

The first appearance of a change is slight diminution of the dark colour; this change goes on gradually, and then small spots appear, which are perfectly white. They gradually increase, and run into each other, and thus a large white spot is formed.

In a former case, where this process had gone on to a great extent, it is said that the black pigment was again deposited, and the skin resumed its original blackness.

These circumstances in negroes have been considered as great deviations from the ordinary course of nature, but a process very analogous to it sometimes goes on in persons who are white. Thus, there are some in whom the skin becomes much browner than natural in some parts of the body, particularly on the arms; and in these brown portions, spots are formed which are much more white than the natural colour of the skin.

In such cases there appears to be a deposition of colouring matter in the rete mucosum of the brown places; while the white spots are rendered more white than natural, either by an absorption of the rete mucosum, or by a deposition of whiter matter in it.

The colour of the rete mucosum sometimes undergoes a temporary change in particular places. Thus, at a certain period of pregnancy, a dark circle forms round the nipple.

In some cases, where the peculiar whiteness occurs, the skin becomes very susceptible of irritation from the rays of the sun;

so as to be blistered, if exposed to them for a short time; this circumstance renders it probable that the colouring matter in the rete mocosum of the blacks, was originally designed to protect their skins from the very powerful rays of the sun to which they are exposed.

There are some persons to be found, amongst most of the different races of men, who are born with this peculiar whiteness of the whole skin, which continues during life. In these persons, the hair has a remarkably white colour, and the eyes are without the pigmentum nigrum. They appear to be in a state of imperfection, and are unable to endure the ordinary light of day. They are generally designated by the epithet of *Albinoes.*

The texture which exists between the cutis vera and the epidermis is probably the principal seat of several important cutaneous diseases; as the Scarlatina Pemphigus, &c.* and from what has been stated, there is good reason to believe that the small-pox, also, commences in it. It is, therefore, much to be wished that its structure was more precisely ascertained.

—The variety of diseases which have their seat in the skin, as well as the important functions which it exercises in health, have led modern anatomists to believe that it was formed of more than the three layers that Malpighi assigned it, and induced them to investigate its structure with scrupulous care. From the innate difficulties of the subject, its anatomy cannot as yet, however, be considered as satisfactorily made out, for its investigators have too frequently resorted to hypothesis, when the means of demonstration failed them. The doctrines of the learned and judicious Malpighi, which have been admirably detailed above, were generally admitted by anatomists,

* In severe cases of the scarlatina, at the termination of the disease, large portions of the cuticle are sometimes detached from the cutis, so that several pratitioners have seen the whole cuticle of the hand come off like a glove. As the texture of the cutis does not appear to be altered in these cases, and the cuticle is also unchanged, the cause of this separation must exist in the intervening structure which connects them.

till M. Gaultier,* a mere student of medicine, full of zeal and candour published in 1813 his researches on the skin, which, though imperfect in some respects, went far towards establishing its real structure.

—The *rete mucosum*, which Malpighi considered a simple coating of mucus, between the cutis vera and cuticle, a sort of varnish covering the papillæ, was considered by Bichat as essentially formed of vessels, and divided by him into two vascular layers, one over the other, in the outermost of which was placed the colouring matter or pigment. But Gaultier, from his observation of the skin of the negro, and Dutrochet from that of quadrupeds, consider it composed of many distinct parts. Gaultier selected for observation the skin of the heel of a negro where the cuticle is thickest, but which he thought differed in no other respect from the skin in other parts of the body.

—This figure is a magnified representation of a section of the skin cut obliquely in regard to its thickness, and transversely to the lines formed by the papillæ. In this, according to Gaultier, we see at *a* the lower surface of the derm, or cutis vera. 1, The prominences or asperities of the derm, forming the papillæ, each one with a slight depression upon the top. 2, Immediately above these and continuous with them we see a series of vascular fasciculi surmounting these prominences, called *bloody pim-*

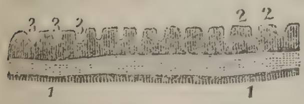
Fig. 108.

* Gaultier, whose opinions have been adopted in the main by Beclard, Blandin, Cloquet and others, would, if he had lived, most probably done much towards simplifying and perfecting his views. Appointed army surgeon immediately after his graduation, he fell a victim to the disasters of the Russian campaign. The investigation has, however, been taken up by Dutrochet who extended it to the skins of quadrupeds, by several of the German and Italian anatomists, and lastly by Breschet and Roussel de Vauzeme. The last have made it a subject of elaborate microscopical research, not only in man, but in the whale and many of the larger animals. The views of Gaultier thus modified and improved, are well deserving of study as the most satisfactory yet given, though, from the doubt which is always attached to microscopical observations, they must be looked upon rather as the probable than the proven structure.—P.

Fig. 109.*

ples, (bourgeons sanguins.) 3, The tunica albida profunda, covering these papillæ upon their top and sides, and united to the upper surface of the derma, and composed entirely of white vessels, (serous capillaries.) 4, Gemmules; a sort of membrane so named from its undulations, excavated on its internal face, which coversi n the tunica albida profunda. This is the seat of the colouring matter of the skin, and each undulation receives two of the bifid tops of the papillæ, called bourgeons sanguins. 5, Tunica albida superficialis, which covers over the gemmules, and is also formed entirely of white vessels. 6, The external face of the skin, which is only the dried surface of the tunica albida superficialis, or the proper epidermis. Gaultier considers four of these layers as belonging to the rete mucosum; the perpen dicular vascular fasciculi (bourgeons sanguins,) the gemmules and the two white tunics.

Fig. 110.†



—The first and second of these four, correspond with the two vascular layers which Bichat assigns to the rete mucosum; and the views of Gaultier differ from this writer's in his adding two more tunics, tun. albid. profunda, and tun. albid. superficialis. But the vascular fasciculi, as Dutrochet and Beclard have asserted, belong to the cutis vera, and form a part of the proper papillary body; and were probably the parts injected by Baynham and Cruikshank—thus leaving the rete mucosum formed of three layers. Thus modified, Gaultier's researches have been adopted by many writers.

—But there were not wanting others who entertained different views. Gall believed the rete mucosum a nervous expansion

* Fig. 109,—Is a representation of the skin, and the basis of the papillæ, the latter surmounted by the vascular villi or fasciculi, (*bourgeons sanguins.*) The space between these fasciculi is filled up, in the natural state of the parts, according to Gaultier, with the tunica albida profunda.

† Fig. 110,—Is a representation of the derm, or cutis vera, with a line of prominences on its upper surface, constituting the basis of the papillæ.

for the reception of tactile impressions; an opinion purely hypothetical and erroneous; Chaussier, that the skin was composed of but two parts, the dermis and epidermis, and that which had been called the rete mucosum was probably a part of the dermis; Blandin,* that the rete mucosum, consisting of three layers according to Dutrochet placed between the papillary bodies and the epidermis, had neither vessels or nerves, was a product of secretion from the papillæ, like the epidermis, and formed in fact a second epidermis thicker and softer than the external, and that it had no more vitality than the hair and nails.

—Breschet and Roússel de Vauzeme,† have in this uncertain and imperfect state of our knowledge, endeavoured with the aid of the scalpel and the microscope, to determine positively its structure. Their researches have been extended not only to the skin of man, but to that of whales and others of the cetaceæ. The discoveries which they allege to have made are surprising, and though their researches appear to have been made with much labour and ingenuity, their confirmation or overthrow must depend upon the investigation of others equally familiar with the same instruments.

—But it must not be forgotten that such high magnifying powers as they have used, expose the most wary and honest observer to optical illusions. This cause led De la Torre, to assert that the globules of the blood were annular.

—According to these writers, the skin consists of but two layers. The derm, or cutis vera, and an external layer, which they call indifferently epidermis, corneous matter, corneous tissue, or epidermic layers, that comprises the rete mucosum and epidermis of other writers, and which they consider composed of the same substance, mucus, in a greater or less state of desiccation. It is, however, composed of many distinct parts, not arranged in the form of layers. Fig. 111, represents an imaginary scheme or plan, in which they have placed together the

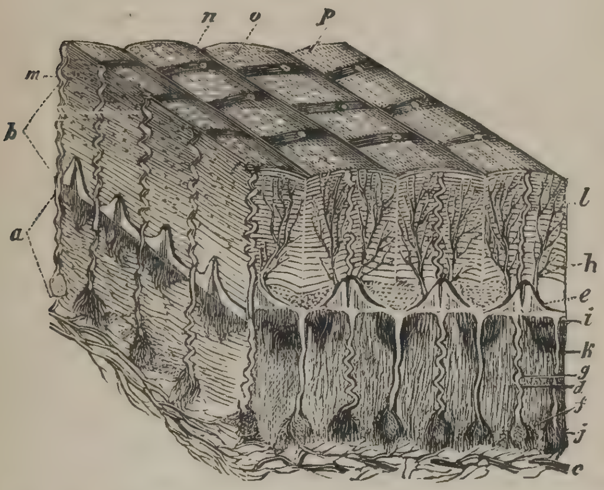
* See Anat. Generale of Bichat, Paris, 1831.—

† Nouvelle recherches sur la structure de la peau, par G. H. Breschet and Roússel de Vauzeme.—Paris, 1835.—

constituent parts of the skin, the existence of which they had proved separately under the microscope.

—Thus, *a* is the derm. *b*, The corneous or horny epidermic matter. *c*, The vessels and nerves which go out from the dermis. *d*, Space filled up by their capillary branches. *e*, Ner-

Fig. 111.*



vous or tactile papillæ. The diapnogenous, or sudoriferous apparatus, composed of a glandular parenchyma, *f*, and of spiral sudoriferous canals, *g*. The glandular or secretory organ is inclosed in the substance of the skin, and the canals pass up between the papillæ and open obliquely on the surface of the epidermis, constituting the microscopical orifices, from which we see the sweat exuding on the palms of the hand, and soles of the feet. *h*, The inhaling apparatus, or absorbent canals, which resemble in many respects the lymphatic vessels: they are situated in the corneous matter, or *rete mucosum*; they are seen to commence under the most superficial layer of the corneous matter which forms the cuticle; no mouths or orifices are seen, and it is impossible to say, whether they commence in the form of a cul de sac or not. They pass down between the papillæ, by the side of the sudoriferous canals, and communicate with

a net-work of vessels, which they believe to be lymphatics mixed up with veins, spread upon the surface of the derm.* *i*, The *organs which secrete the mucus*, of which the rete mucosum and cuticle is formed, or *blennogenous apparatus;* this consists of a glandular parenchyma situated in the thickness of the derm, and of short excretory canals *k*, which deposit the mucous matter between the bases of the papillæ. The chromatogonous organs or glands, which secrete the colouring matter or scales, run parallel with, and immediately below the grooves on the surface, and between the papilli, which they are also placed a little below. The ends of them, marked by a collection of dots, can of course only be seen in the plan, in consequence of their running parallel with the grooves, and between the parallel ranges of papillæ.

—They consist of a glandular parenchyma, receiving an abundance of capillary vessels from the derm below, and possessing excretory canals above, that throw upon the surface of the derm, the colouring principle, which is mixed with the soft and diffluent corneous or mucous matter, secreted by the blennogenous apparatus. From this mixture results the pretended rete mucosum of Malpighi, and the epidermis or cuticle. From this apparatus is also produced, they think, the horns, scales, spines, bristles, hair, wool, hoofs, nails, etc. of different animals. It is solidified in successive couches, to the right and left, as seen in the section across the grooves, *l;* but in the longitudinal section *m*, these layers present a series of straight lines one above another like the leaves of a book.

—In consequence of this arrangement, the corneous matter, when macerated, throws off layer after layer. The superior face of the epidermis presents grooves, as represented at *n*, which correspond to the interpapillary grooves of the derm. *o*, Are the prominent ridges in the cuticle formed over the papillæ, separated by transverse grooves, *p*, at the bottom of which are found the pores of the sudoriferous canals. *e*, Are

* The existence of these inhalent vessels, from some observations I have made with a very powerful microscope, I should consider extremely doubtful.—P.

the vessels and nerves which enter into, or go out from the derm. *d*, An interval filled up by capillary filaments.

Of the Derm.

—The external surface of the derm, is lined by a very thin adherent membrane, which is reflected over the tops of the papillary bodies and forms their neurilema. The horny or epidermic matter is secreted in the grooves between the papillæ, and is moulded around all the inequalities, the form of which is exactly impressed on all the layers of the epidermis. In serpents, the *derm*, has a singular arrangement; it is elevated in imbricated projections, covered by a thin layer of epidermis; these are called scales. In fishes, on the contrary, the surface of the derm is smooth, and the scales are formed only of the horny matter. The derm is a membrane, the fibres of which are solidly interlaced together, with interstices for the passage of vessels, nerves and canals, and in which are lodged many organs, as has been shown in the plan, page 423.*

Of the Papillary Body, or Neurothelic Apparatus.†

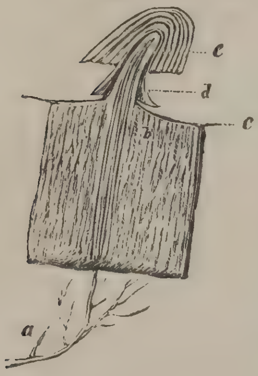
—This consists of a series of little prominences on the upper surface of the derm, the cleft at the top into two portions, each of which is composed of a bundle of nerves and vascular filaments—the *bourgeons sanguins* of Gaultier. The form of each papilla is that of a cone. The base is expanded in the upper surface of the derm, and its two prominences or villi, terminating in a rounded point, are received in the horny layers of the epidermis, like a sword in its sheath, (see page 426.)
—The direction of the papilla is slightly oblique in the epider-

* The method adopted by these writers for microscopical examination of the skin, was to take a piece of recent skin in which the vessels were distended by cadaveric accumulation of blood, or filled with injection. A portion from the heel is preferable. This is to be allowed partially to dry, and the thinnest possible transparent slice, cut off vertically. This is to be placed upon a piece of moistened glass and examined under the microscope with the use of a lamp and reflector. In this way they were able readily to see, and isolate with curved cataract needles, all the versels, nerves and glandular apparatus of the skin.—P.

† From *neuron*, nerve, and *thela*, papilla.—

mic layers, as seen in fig. 112.* The nerves are here seen passing up into the papillæ through the dermis; the vascular branches which accompany them are not here represented. The papilla first gets a neurilematic covering from the upper surface of the derm, and is there furnished with several layers of the epidermic horny matter, which cover it like a hood. This horny covering is particularly thick at the heel, and serves to protect the papillæ by the deadening of shocks, and resisting the pressure of the weight of the body. The papillæ are most numerous on the palms of the hands and soles of the feet, but are also scattered over other parts of the body.‡

Fig. 112.†



Of the Sudoriferous or Diapnogenous Apparatus.

—This consists of a gland, see fig. 111, p. 423, placed in the substance of the dermis, near its inner surface, into which a great many capillary vessels run, and of a spiral duct which runs up through the horny layers and opens obliquely through the outer epidermic crust by a slight depression or pore, on the

* According to these writers the nerves, as they pass up from the under surface of the skin, become soft, flexuous, and capillary, and as they enter the villi on the top of the papilli, lose their neurilema, and are expanded in the form of pulp. They look upon the changes which the nerve undergoes, and upon the derm, villi, and epidermic covering, as so many parts necessary to constitute the perfect organ of touch: thereby assimilating it to the more complicated organs of sight and hearing. —Loc. cit. p. 15, et seq.—

† Fig. 112, represents the apparatus which constitutes the organ of touch in man. *a*, Nerve entering into the dermis, where it becomes capillary. *b*, Its entry into the papilla. *c*, Neurilema furnished by the dermis.! *d*, Proper envelope of the nerve. *e*, Corneus layers more or less thick, which form the organ of protection to the nerve. The capillary blood-vessels which pass up with the nerves are not here shown.

‡ From their observations upon the papillæ of the whale, these anatomists are disposed to believe that the nervous fibrils terminate at the top of the villi, by loops with one another, as Prevost and Dumas have shown them to do in other parts of the body.—

back of the epidermic ridges, formed over the papillary bodies. These are the orifices from which the sweat exudes, and may be readily seen with a single lens of moderate magnifying power, on the palms of the hands, soles of the feet, nose, and other portions of the body. The obliquity of the orifice, gives it a valvular arrangement, like that of the ureters where they enter the bladder. In consequence of this the valve closes the orifice, when the epidermis is raised by cantharides, and the duct is broken off, so that the pores are not generally visible; this has occasioned some anatomists, of great reputation, (J. F. Meckel, Cruikshank, Blumenbach, etc.)* to deny altogether the porosity of the epidermis, and to believe that the sweat passed by exudation or exosmosis directly through its substance. In carefully elevating the cuticle from the subjacent coats, these ducts are visible as very fine transparent elastic filaments; the spiral being converted into straight tubes by the traction, and which W. Hunter, Bichat, and Chaussier, according to these writers, mistook for the exhalent and absorbent vessels.† Others supposed they were filaments of cellular tissue, uniting the epidermis to the subjacent layer.‡ The sudoriferous organs, which are exceedingly numerous, are probably the only exhaling organs of the skin.

The Inhaling Apparatus.

—This is properly an appendage of the absorbent system; and may be seen, according to these anatomists, with a lens of feeble magnifying power, or even with the naked eye, in raising the epidermis with proper precaution. They have not, however, been enabled to make out their anatomy satisfactorily.

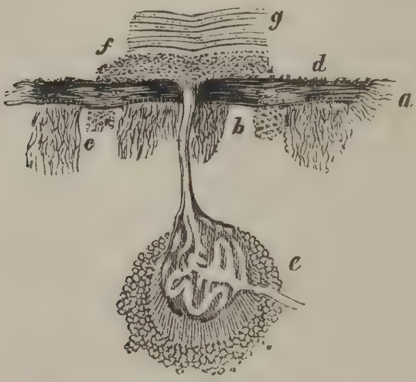
* Beclard was disposed to consider these pores as the orifices of the sebaceous glands, though he expresses himself doubtingly upon the subject, and says that the rout by which the sweat traverses the epidermis is entirely unknown.—P.

† The existence of exhalent vessels, was a mere presumption of Bichat, and has never been demonstrated.—P.

‡ Eichhorn has also observed these sudoriferous canals, and his description of them corresponds in many respects with that of Breschet. (Memoire sur les exhalations que se font pour le peau, et sur la voies par lesquelles elles sontlieu ; par Henri Eichhorn.) Arch. de Meckel.—P.

They describe them, see fig. 111, as arising by isolated radicles from the under part of the grooves of the epidermis, and not opening to the surface; the fluids which they take up getting into their cavities by previous imbibition through the outer cuticular covering. In passing downwards towards the derm, they are in company with the sudoriferous ducts, and in the substance of the derm, become continuous with the common absorbent vessels.*

Fig. 113†.



Blennogenous Apparatus,

—Or organs that produce the mucous substance, which, in its first soft condition, forms the mucous body, heretofore known under the name of rete mucosum, and which, hardened upon the surface constitutes the horny matter of the epidermis.

* The existence of these absorbent vessels immediately beneath the cuticle and on the upper surface of the dermis, has been demonstrated by Tiedemann, Fohman, and Lauth. Breschet asserts the discovery of an additional structure, in his *inhaling apparatus*, arising in the corneous tissue.—P.

† Fig. 113.—*a*, Chromatogenous organ torn in two places, *b* and *c*, to show the escape of the scales, and the thread-like vessels of which this organ is composed. *d*, Its small excretory canals, torn in removing the corneous matter. *e*, Blennogenous or mucous gland, which throws its secretion above the chromatogenous organ. *f*, Fluid state of the corneous matter, that is to say, pigmentum or scales floating in the midst of mucus, (rete mucosum of Malpighi.) *g*, Layers of corneous or horny matter stratified to the right and left, more and more condensed, the nearer they approach the surface. Into the mucous gland is seen running a sanguineous vessel, and round it are placed a number of little whitish granules.

To see these well with the microscope, it is necessary to have a piece of fresh skin well injected with blood. There is then to be seen at the base of the derm, little reddish glands, irregular on the surface and grooved by blood-vessels. They are enveloped in cellular membrane and surrounded by a multitude of minute adipose vesicles. From the top of each of these glands as seen in fig. 113, passes up a duct, which opens on the upper surface of the derm in the grooves between the papillæ. Many capillary vessels adhere to the tube and the gland, and a vessel of considerable size enters the base of the latter. The mucous matter thrown on the surface of the derm by these organs, quickly unites with a colouring matter, from which results the different tints of the corneous or epidermic substance, hair, nails, scales, feathers, etc. in man and other animals. This colouring is formed by the

Cromatogenous Apparatus, (see fig.* 113,)

—which is placed at right angles to the ducts of the mucous glands, at the upper surface of the derm, and at the bottom of the grooves. Its structure is parenchymatous or spongy. On its under surface, it receives a great number of minute capillary vessels, which is the outer limit of the vascular system, with the exception of the vessels which pass up into the villi. On its surface arises many short ducts, and which open in the grooves between the papillæ, to convey up the colouring matter in the form of small granules to mix with the mucus.† When this tissue is torn, a great many small filaments are seen (*a*,) from which escape small scales or colourless corpuscles in great quantities. (*b*, *c*.) This reservoir of scales is found in no other part of the derm.

—At *f*, is seen the fluid state of the corneous matter—that is to say, the pigment of the scales floating in the midst of the mucus. At *g*, couches of this matter, hardened and stratified,

* From χρωμα, colour, and γεννάω, to create.—P.

† The colouring matter as is very obvious in the black, is now found to be deposited in delicate hexahædral cells which are called *pigmentary cells*. In the choroid coat of the eye the cells are arranged in several layers over each other, so as to form a pigmentary membrane, the surface appearing perfectly black.

to the right and left as they approach the surface, form the coverings of the papillæ, and which are thus secreted and moulded around these organs.

—The whole of the corneous tissue of the skin, (included usually under the terms of rete mucosum and epidermis,) is formed according to these anatomists of the mingled products of these mucous and colouring glands.*

The Cuticula or Epidermis,

has been examined with the greatest care by several of the most successful anatomists; but notwithstanding their labours, the structure of this substance is by no means understood.

It appears to have some resemblance to the matter of the nails, and of horn: but is rather more flexible, even after allowing for the difference in thickness.

In those parts where it is thinnest it is semitransparent.

It is insensible, and no vessels can be seen in it. †

* In investigating this obscure and difficult part of anatomy, it has been usual with observers to select the skin of the palms of the hands and soles of the feet, as a type of the whole cutaneous system. There is, however, a difference to be observed. In the palms and soles resides pre-eminently the sense of touch. These parts are likewise destitute of hair, and the papillæ which are there very numerous and visible to the naked eye, are very sparsely distributed and appear rudimental in other parts of the body. Much of the discrepancy among anatomists in regard to the structure of the skin, appears to be owing to whether they have made their researches mainly upon the palms and soles, or upon the skin of other parts of the body. Chevalier* and Wallace,† have described, especially in the skin of the face, arms, and legs, a system of *epidermoid glands*, seated in the rete mucosum, and so minute that the latter counted one hundred of them in the one-twenty-fourth part of a square inch, and which gave issue to the sweat. These appear to me, to correspond with the *diapnogenous apparatus* of Breschet, as he represents them in the palms and soles.

The opinion of Bichat, is therefore erroneous, that the sense of touch is only more perfect in the hands than other portions, in consequence of the shape of the parts, and the facility with which they may be applied round objects, and that the skin of the abdomen substituted for that of the fingers, would have constituted organs of touch.—P.

† In the early part of the last century, an anatomist by the name of St. Andre, exhibited a preparation of the cuticle which appeared to be injected with mercury. Ruysh declared the thing impossible, and invited him to an investigation of the subject. This invitation was not accepted, and the affair has been generally considered as a mistake or an imposition.—H.

* Lectures on the general structure of the human body, and on the anatomy and functions of the skin, by J. Chevalier.

† Lectures on the structure of the skin, by W. Wallace, London Lancet, 1837.

It extends over the whole external surface of the body, except the parts covered by the nails, and is accommodated to the surface of the skin, by forming ridges or furrows, corresponding to it.

It adheres most closely to the cutis; and when abraded by mechanical violence, the surface of the skin appears moistened by effusion.

It is not certain that its mode of union with the skin is perfectly understood; the adhesion of these membranes to each other is as uniform as that of two smooth surfaces glued together, but it is generally said that the cuticle is attached to the cutis by very numerous and fine filaments.

It has often been asserted that these filaments are the exhaling and absorbing vessels, which pass through the cuticle, to and from the skin. This sentiment appears very reasonable, but no vessels that pass in this way can be injected.

There are innumerable processes which pass from the cuticle to the skin. Many of these are the linings of the cavities which contain the roots of the hairs; but they are reported by microscopical observers to be like the fingers of a glove, closed at their extremities.

There are also many processes which contain a sebaceous substance that may be pressed out of them in the form of worms; these are the ducts of sebaceous glands.

Besides these, there is an immense number of whitish filaments, which are as fine as the most delicate thread of a spider's web. These filaments can be best seen while the cuticle is separating from the skin of the sole of the foot, as suggested by Dr. William Hunter.* They are supposed to be vascular, but they have never been injected.

When the cuticle is in its natural situation, in union with the skin, there appears to be three species of foramina or pores, on its external surface: viz. 1. Those formed by the passage of the hairs; and 2. Those which are the orifices of the ducts of the sebaceous glands; each of which has been already men-

* See the London Medical Observations and Inquiries, vol. ii.—H.

tioned. And 3. Such pores as exist on the ends of the fingers and the inside of the hands.

It is said that these last are very visible, when magnified to twice or thrice their original bulk, and drawings of them have accordingly been made by Dr. Grew* and by Mr. Cruikshank.† Small specks of fluid can be seen with the naked eye, in the same situations, in warm weather, or when the ends of the fingers are made turgid by a ligature. It is probable that they are formed by the accumulation of fluid at these orifices.

The above described pores are situated on the ridges at the ends of the fingers and not in the furrows; and it is probable that similar pores are distributed over the surface of the body.

Notwithstanding the appearance of these foramina, when the cuticle is in its natural situation, several of the most successful investigators of the subject have declared that they could not discover any pores or foramina in the cuticle, when it was separated from the cutis.

The late Professor Meckel of Berlin, who was one of this number, was induced to believe that the matter of exhalation, and of absorption, soaked through the cuticle, as the vapour of warm water passes through leather.‡

In support of this doctrine he states that perspiration goes on through the cuticle on the palms of the hands and soles of the feet when it is very thick; and observes, that if it were transmitted by delicate vessels, the vessels in the feet must be torn by the weight of the body, in persons who walk; and those in the hands would experience the same fate, in labourers, who work with heavy hammers, &c.

On the other hand, Mr. Cruikshank, who could likewise find no pores in the separated cuticle, contends strenuously for their existence notwithstanding; and explains their non-appearance by the following facts, among others; viz. that no foramen will appear in the separated cuticle, although it has been punctured by a needle; and that when the cuticle has been peeled off,

* In the Philosophical Transactions, vol. iii. Lowthrop's Abridgement.

† See his Experiments on Insensible Perspiration.

‡ See Memoirs of the Royal Academy of Sciences of Berlin, vol. xiii. for 1757.

from portions of the cutis on which were hairs which must necessarily have perforated it, no foramina have appeared in it.

M. Bichat took very different ground: he asserted that the pores of the separated cuticle were to be seen distinctly, in large numbers, by looking through it towards the light; he also believed that the course of the exhalent vessels, through the cuticle, might be seen in the same manner; and that they passed obliquely.

That the cuticle is pervious, is proved incontestably by the functions of perspiration and sweating, as well as of absorption; but there are good reasons for believing that the perforations of the cuticle have a peculiar structure; and are not simple foramina. Thus, when a vesicle is formed by the operation of cantharides or any other process, if the cuticle is not lacerated, it will confine the effused fluid for a considerable time, without any appearance of its escape through these pores.

This fact, which is strongly opposed to the hypothesis of Meckel, is explained by Cruikshank upon the supposition that the pores of the skin are lined by processes of the cuticle, and that when the cuticle is separated from the cutis, these processes go with it, and act like valves in confining the fluid.

Bichat supposes the oblique vessels to produce the same effect upon analogous principles; and compares their situation to that of the ureters, which pass obliquely between the coats of the bladder.

This peculiar quality of the cuticle, in admitting of perspiration and sweat, and also absorption, while it prevents evaporation from the parts which it encloses, is of immense importance.

If a portion of skin be deprived of cuticle a short time before death, by a blister for example, this portion will, in a few days, become perfectly dry and hard, like horn; while the other parts of the skin of the subject, covered by the cuticle, retain their moisture and flexibility.

It may, therefore, be admitted, that the use of the cuticle is to keep the skin soft and flexible, by confining its moisture, as

well as to defend it.* And it is probable that the sebaceous matter is secreted for the purpose of preserving the cuticle in a state of flexibility.

As the cuticle is capable of confining fluid, and resisting the action of chemical agents, it is surprising that epispastics and rubefacients should act through it, upon the skin, with so much certainty as we find they do; and that cantharides should produce vesications, when applied dry.

The thickness of the cuticle on every part of the body is much increased by long continued pressure, forming corns and excrescences of its own nature. By this cause also it is rendered very thick on the palms of the hands and soles of the feet; although it is originally thicker there than in other parts.

It is said that, after long boiling, these thick portions of cuticle may be separated into distinct lamina.

In the living subject, the cuticle, when immersed in warm water, seems to absorb some of that fluid; as is evinced by the hands when they have been long in that situation; and also by those parts of the skin to which poultices have been applied.

Notwithstanding the uniform adhesion of the cuticle to the cutis, it is observed, in the living subject, to be separated, and formed into vesicles, by a variety of causes, viz.

1. Pinching of the skin, or violent mechanical irritation; such as labouring with hard instruments.

2. By the application of cantharides, and certain other substances which produce vesications. Sometimes these substances appear to inflame the skin; but on other occasions the vesication is produced while the skin appears unchanged in colour, and free from inflammation. The process appears different from that of simple inflammation; for certain rubefacients often inflame the skin considerably without vesicating or blistering it.

3. Boiling heat will, very generally, produce vesication.

4. Certain diseased processes seem to occasion vesication in

* This property of the cuticle is rendered very apparent in attempting to dry anatomical preparations with the skin on, in which the student will fail, unless the cuticle is previously removed by maceration.—P.

a manner which is not well understood, viz. *erysipelas*, *zona*, or *shingles*, *pemphigus*, and some other eruptions which have no name. In erysipelas there is an obvious inflammation of the skin; but in some of the other diseases the vesication takes place without the appearance of inflammation.

5. Vesications often appear when there is a tendency to gangrene.

6. They also occur in some cases of simple fracture, where there is considerable injury. In these cases the fluid effused is often tinged with blood.

After death the cuticle is separated from the cutis:

1. By putrefaction; in which case large vesicles are sometimes formed.
2. By long continued maceration.
3. By boiling, and
4. By violent dry heat.

The cuticle appears to be least deranged when it is separated by putrefaction and maceration: in these cases the internal surface corresponds to the surface of the skin; and the processes which contain the hairs, as well as those which are the ducts of the sebaceous glands, are particularly obvious.

The external surface of the cuticle varies in different places, according to the surface of the skin. In some places it appears scaly at times, and has therefore been supposed to consist entirely of scales; but in other parts, when examined attentively, it appears like a half transparent concreted substance, with a rough surface.

When the skin has continued dry for a long time, bran-like scales can be rubbed off from it. These are probably composed of the residuum of the secretion deposited on the skin, and of a portion of the external surface of the cuticle. The same substance appears upon the first washing of the skin, after that process has been discontinued for any length of time.

Many speculations have arisen respecting the manner in which the cuticle is originally formed, and reproduced; but none of these are perfectly satisfactory.

It is also a question whether the cuticle is endued with vitality,

or is merely an inanimate unorganized concrete. No decisive argument have been adduced in favour of its vitality; and it has already been stated, that neither nerves nor vessels can be demonstrated in it.

It appears particularly calculated for protecting the skin which it covers; for it is insoluble in water, and resists the action of several powerful chemical agents. Thus, it is not affected by immersion for a considerable time in the sulphuric and muriatic acids; although the nitric acid acts upon it.

It resists for a short time, but is at length dissolved, by the pure fixed alkalies, and by lime.

It is supposed by the chemists to consist of albumen, in a peculiar state of modification.

—Malpighi, was the first to discover, by the use of the microscope, an intervening substance between the cuticular covering, and the cutis vera, which he called the *rete mucosum* or *corpus reticulare.* This he considered the seat of coloration in the negro, and asserted the cuticle to be alike in all varieties of the human race—that is, colourless. For a long period his researches formed the basis of all the systematic treatises upon the skin, and it is only within a recent period, as has before been observed, that the study of the subject has been resumed. —The cuticle of the black is now generally admitted to be of an ashy colour.* And Flourens† has shown, that the reticular appearance of the *rete mucosum* is entirely an adventitious circumstance. Malpighi first discovered his rete mucosum on

* Breschet has asserted that the colour of the skin in different animals is dependent upon the form of the scales of the epidermis, by which the light is reflected.

Fig. 114.

The larger cut represents, after this observer, the scales of the epidermic or corneous matter of a white man, diluted with water, and highly magnified, in which are seen fragments of the sudoriferous canals and inhalent vessels. The scales all have a trapezoidal or lozenge shape. The smaller cut, represents a single scale from the skin of a whale, highly magnified. It is black at its summit, and whitish at its pedicle of insertion. The skin of the whale is black, and these writers assert, that in all animals with black skins, including negroes, the scales of the epidermis, appear under the microscope of this shape or spatulate.—P.

†Annales des sciences naturelles, 1837.—

the tongue of the ox, and subsequently under the epidermis of the human hand, from which he drew his description. By ebullition he softened the outer covering of the cutis vera, and then tearing off the epidermis, he saw a layer of soft substance with holes in it like the meshes of a net. This was owing to a laceration of the mucous layer: the part covering the apices of the villi going off with the cuticle, while that between the villi and the bases of the papillæ adhered to the cutis vera. By maceration in water, which is the surest and most successful method of effecting a dissection in delicate parts, Flourens, found in the same organs the cuticle to come off, leaving the whole of the mucous body attached, which then presented none of the reticular appearance. The cuticle and mucous body were both continuous layers, covering the papillæ and forming their sheaths. The sheaths formed by the latter body were broken in Malpighi's preparation.

—The cuticular sheaths in the ox, were thin and delicate over the fungiform or smaller papillæ, but formed thick horny layers over the larger which assist in the action of mastication.

—Albinus, repeating the experiments of Malpighi, corrected his error, and in the beautiful designs of Ladmiral, has represented the mucous body as a continuous layer. Since then by Bichat and others, the use of the term rete mucosum, has been continued, not exactly in the original signification of Malpighi, but under the belief that it contained a net-work of vessels. Its foliated structure has been well established by Cruikshank, Gaultier, and Flourens. It thus appears that the whole of the anatomy of the skin, requires to be constructed anew. Several of the German and French anatomists have applied themselves to the task, among whom may especially be mentioned Weber* of Leipzig, and Breschet of Paris.† The views of the latter, on account of his having treated the subject more extensively than the rest, as well as from his high situation in the school of Paris, have already been given. The physiology

* Arch. fur die Physiologie.—

† Nouvelles Recherches sur la Structure de la Peau, par G. W. Breschet et Roússel de Vauzeme. Paris, 1835.—

of cuticle has received an entirely new aspect, from recent observations, and especially from those of Henle.* He has shown that with very few exceptions, all the free surfaces of the body—not only the skin which has its cuticular covering—but those of the serous cavities, the mucous passages,† the blood-vessels, and the ducts of the glands, are invested by a membrane, composed of one or more layers of primary cells, forming a delicate cuticle or epithelium. The epidermis, cuticle, or external covering of the skin, when examined with a powerful microscope, is seen to be composed of several layers of cells, which are the consequence of an uninterrupted process of exudation which has place upon the corion or true skin. This exudation, though unorganized, retains some vital properties, and is a *cytoblastema;* that is, a basis structure, or soil, from which new growths or developements take place. These new growths are *cytoblasts*, or cell germs; that is, cells or vesicles, at first globular, afterwards lenticular and opaque, (each one surrounding a central nucleus), which possess within themselves the inherent principles of growth.‡ The more recently produced cells, which of course are those in contact with the corion, are like all young cells, spherical in their figure; they become flattened as they develope themselves and approach the surface; so that when examined on a section, they are found to have undergone changes of form from that of a globular cell, provided with a nucleus, to that of a flat scale, in which no trace of a nucleus appears, and which lay, one over another, like so many layers of tiles or pavement. The innermost layers are soft and cellular; the outer ones become dried on the surface from exposure to the air, and fall off in squamæ or scales.—§

* Allgem. Anat., p. 260.

† Vide Gen. Anat. of Serous and Mucous Membr. Vol. 2.

‡ The cell germs, here and in other parts of the body, bear a general relation to the size of the blood globules of the same individual. This is a remarkable fact, and somewhat in favour of the views of Dr. Barry, who states that it is the blood disks that are transformed into these cell germs.—Phil. Trans. Part 11. 1840.

§ Henle, makes three varieties of epithelium or cuticle, 1st. The *pavemented squamous* or *tesselated* epithelium, above described, found on the skin, serous mem-

The Nails.

The roots of the nails appear to originate in a fold of the cutis vera, from the epidermus which lines the fold; but the bodies of the nails adhere firmly to the cutis on which they lie, and appear to cover it, in the place of the cuticle. The papillæ of those parts of the cutis which are covered by the nails are very conspicuous when the nails are removed. It has been supposed that there was no rete mucosum between the nails and cutis; but this opinion is probably erroneous, as the black pigment is perceptible under the nails of some negroes.

The nails can be separated from the cutis by all those processes which separate the cuticle from it. When this is effected, they remain connected with the cuticle, which appears to be continued into them; and on this account, as well as their insensibility, and their resemblance to the horny excrescences of the cuticle, they are considered as appendages of it.

The root is opaque, and appears white. The body is transparent, and in health shows the florid colour of the cutis which it covers; but the colour of this portion of the cutis depends upon the state of the circulation; and becomes livid when the blood is disoxygenated, or when the circulation ceases there; and this colour also appears through the nails.

The nails are unquestionably organised, although their ultimate structure is not known. They appear to be composed of lamellæ, and these lamellæ of fibres. They grow rapidly, and when they are not pared or worn away, they sometimes acquire an immense size.

As a remarkable instance of this, it is related, that a nail of the great toe was sent from Turin to the Academy of Sciences at Paris, which measured four inches and a half in length.

The growth seems to take place altogether at the roots.

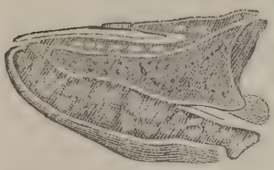
The nails, when chemically examined, appear to consist of

branes, the lining membrane of the mouth, pharynx, œsophagus, and the vagina and cervix uteri. 2d. The *cylinder* epithelium, found in the remainder of the alimentary canal, the ducts of the glands, and a great part of the genito-urinary apparatus of the male. 3. The *ciliary* epithelium, found in the respiratory organs, the lachrymal passages, Eustachian and Fallopian tubes, etc. Vide the account of these organs.

a modification of albumen; and thus resemble cuticle and horn in their composition.

—The growth of the nails, forwards, is entirely from a fold of the cutis vera, at its root, called, though not with exact propriety, the matrix of the nail, as seen in fig. 115. It grows also in thickness from the upper surface of the skin, upon which the nail rests. In the formation of a new nail the lamen which starts from the matrix, receives successive layers, as it approaches the extremity, the deepest seated of which is the shortest. In this way the nail gets its thickness and strength, and occasionally, where the deposition of new matter, goes on more rapidly under the body of the nail than at the matrix, the body is thrown up into unsightly rugosities. Its developement is exactly similar to that of the horns and hoofs of animals. The striated appearances of the nail, is said to be owing to the papillary prominences below. The white semicircular line at the root, is called the *lunula*.

Fig. 115.*



—The nails are not exactly analogous in structure to the cuticle, in the ordinary acceptation of the term—to that part which is raised up under a blister. The proper cuticle is that thin coating which is scraped away and worn off near the root, and which otherwise would cover the surface. The nails consist of the proper cuticle, and tunica albuginea superficialis and gemmules of Gaultier—leaving interposed between them and the cutis vera, the tunica albuginea profunda which is insensible, and explains why it is that a splinter, or the blade of a small pair of scissors, in the operation for onychia, may be run along close on the under surface of the nail, without the production of much pain. According to Breschet, the nail is formed like the other parts of the horny coat exterior to the cutis vera, by the glands for the secretion of the mucous and colouring matter; the products of which would be mixed up together, colouring the substance of the nail, as we know is the case in regard to the horns and hoofs of animals.—

The Hairs

Originate from bulbs which are situated at the bottom of pores or cavities in the skin. These pores appear to be lined by a production of the cuticle, and the extremities of the bulbs project beyond them into the cellular membrane. In some cases, where the cuticle is separated after putrefaction, it seems that these lining processes of the cuticle come away completely, and bring the hairs and roots with them; but in other cases, the cuticle separates from the cutis, and leaves the hairs in their natural situation.*

When viewed in a microscope, the bulb appears half transparent, and whitish; and of a softer consistence than the hair itself. The extremity of it is remarkably flexible, and sometimes much darker than the rest of the bulb. The hair does not appear to extend completely to the end of the bulb. Neither blood-vessels nor nerves have been traced to these bulbs, although it is probable they extend there: for the operation of extracting hair by the roots is generally very painful; and blood sometimes appears in the pore from which the hair is extracted.

The body of the hair appears to be composed of smaller fibres, enclosed in a membrane which often is imperfect at the extremity; in consequence of which the fibres often separate from each other, or split.

Within the hair is diffused the substance upon which its colour depends: this does not appear to be essential to the structure, as in the advance of life the hair is so generally without it, while its structure continues unchanged, although it becomes less flexible.

The colour of the hair appears to have some connexion with

* Dr. Dom. Nardo, of Padua, asserts that he has succeeded frequently upon himself, in transplanting a hair with its bulb, from one of the pores of the head into one of the pores of the chest; which is done by enlarging the latter pore with a needle, introducing the bulb into it with exactness, and exciting a slight inflammation around it by friction. The planted hair takes root, grows, and in process of time, undergoes the usual changes,—becomes gray, and is shed.—*Giorn dell' Ital.*—

the colour of the rete mucosum, as it is so generally black when the rete mucosum is dark coloured.

The sudden change of colour in consequence of fright or grief, is a very rare occurrence indeed; but Bichat relates an instance which came under his observation, in which the hair became perfectly white in one night, in consequence of grief.

—The substance of the hair is of a corneous nature like the epidermis. Each hair consists of two parts, a bulb or follicle, and a stalk or hair proper.

—The follicle is ovoidal, and consists of two membranes. The exterior is white, firm, and continuous with the cutis vera; the interior, which is thin, soft and reddish, appears to be continuous with the rete mucosum.

—The cavity of the follicle is filled up at the bottom with a conical papilla, into which, according to Beclard, the nerves and blood-vessels may be seen running below. Rudolphi and Andral, have traced nerves into the whiskers of the seal; Shaw has done the same, and discovered that they were branches of the fifth pair. The root of the hair possesses a conical cavity, in which is lodged the point of the papilla which appears to secrete the matter of the hair, and cause its growth, by the continuous deposition of new matter at its root, as takes place in regard to the nails of man, and the horns of animals; this deposit of new matter in the fluid state, has been seen between the hair and papilla. It is sometimes secreted in profusion, especially in the head; and has appeared to me, by overflowing from the follicles, and drying in the form of scales, to be the source of the dandriff.

—The epidermis is reflected from the mouth of the follicle, and lost upon the surface of the hair.

—The hair, when examined with the microscope, appears to be covered externally with small scales, and to be hollow internally. The latter, however, appears to be in the human hair, an optical illusion. The stalks of hairs have neither vessels nor nerves in their structure, and anatomists no longer admit

a fluid in their interior described by Bichat and others as the marrow.*

—Around the orifices of the follicle, and in the substance of its neck according to Gaultier, we find a number of minute sebaceous glands, that secrete an unctuous fluid, which imbues the hair and preserves its softness and pliability. The hairs are hygrometrical, and increase in length and thickness when exposed to humidity; and are shortened again by dry heat.

—From the changes which take place in regard to the colour of the hair, there is reason to believe, that it is transversed by some fluid. This passes along the hair by imbibition, from the root upwards, in consequence of its hygrometrical nature, passing up through the spongy or cellular tissue of which the body of the hair appears to me to be formed. This fluid is derived from the surface of the skin forming the papilla, and is analogous to the fluid of the rete mucosum, and corresponds more or less in colour with that of the skin and iris.

—The hairs vary much in size, but appear all to be constructed on the same plan. They have different names in different parts of the body, as beard, whiskers, eyelashes, &c. The minute hairs generally spread over the body, are called down or duvette, and those which cover the scalp, in man, have particularly appropriated to them the term of hair. In the white or Caucasian variety of the human race, the hairs of the head are very numerous, fine, long, and vary in colour from white to black: in the Mongolian they are straight, black and short: in the Negro, black, fine, thick and crisped: in the Indian, black, straight, fine and thick: and in the Malay, thick and frizzled.

—Their size and number vary in regard to their colour. Withoff, has calculated that in a quarter of an inch square of skin there are one hundred and forty-seven black hairs, one hundred and sixty-two chestnut, and one hundred and eighty-two, blond.

—The hairs are composed chemically, agreeably to Vauquelin,

* Note to Bichat, 4th edit. Paris.—

chiefly of animal matter, of some concrete white, and some black oily matter; iron, oxide of manganese, phosphate and carbonate of lime, silex and sulphur. The change of colour to gray, is said to be owing to a preponderance in the formation of the white oily substance, and the developement of some phosphate of magnesia.* The shape of the hairs vary in different parts.

—From the large size of the nerves which enter the papillæ, to which the hairs are attached, they become in many animals delicate instruments of touch. The formation of the hair depends upon the follicle; while this remains healthy, though the hair should be removed by its roots, it will again be reproduced.

—Boucheron in a recent work on the hair, says that in baldness the bulbs are often only partially atrophied, a circumstance which does not render hopeless the idea of their recovering their original functions, and re-secreting the horny matter which forms the hair, under the influence of certain stimuli.

—Round the bulbs of the larger hairs, are found some smaller ones, which, as seen in extraction of the former in some cases of tinea capitis, are sometimes developed to an unusual extent.

—It has also been frequently observed, that in many women the almost imperceptible down of the face presents, after the fortieth or fiftieth year of age, a great increase of developement. The bulbs of the hairs are obliquely and confusedly implanted in the dermis—hence when one straggling white hair is extracted from the head, the neighbouring ones speedily whiten in their turn from the disturbance and injury which their bulbs have suffered.

—There are many hairs, which are developed so feebly that they do not pass the epidermis, but roll and curve themselves under it. From accidental circumstances the energy of the bulbs of these hairs is sometimes so increased, that skin which had been previously smooth, becomes hairy. Boucheron, attributes the colour of the hair to a peculiar animal oil, secreted

* C. P. Ollivier.

by the bulbs, and varying consequently in its properties in different individuals. It is to a change in the colour of this oily matter, arising from a variety of causes, which enfeeble the general system, as grief, intense study, &c., that is attributed the whitening of the hair.—

The SKIN, constructed as above described, answers a fourfold purpose in the animal economy. It is the organ of touch. It covers and protects the whole structure. It is the outlet for a large proportion of the insensible perspiration, and it performs to a certain extent absorption.

Many facts have been noticed by practitioners of medicine, which prove that it has a connexion with the lungs and stomach, which is not yet explained by anatomy.

As one of these, an effect of the urticaria or nettle-rash may be mentioned. This eruption sometimes relieves completely the spasmodic croup; and in other cases, nausea and vomiting.

Some children, when affected with this species of croup, are relieved by rubbing the skin with harsh woollen cloth.

In some places, the urticaria and the affection of respiration are so much regarded as symptoms of the same disease, that the term *hives* is used as the name for each of them.

PART V.

OF THE NOSE, THE MOUTH, AND THE THROAT.

CHAPTER XII.

OF THE NOSE.

The prominent part of the face, to which the word *nose* is exclusively applied in ordinary language, is the anterior covering of two cavities which contain the organ of smelling.

These cavities are formed principally by the upper maxillary and palate bones; and, therefore, to acquire a complete idea of them, it is necessary to study these bones, as well as the os ethmoides, the vomer, and the ossa spongiosa inferiora, which are likewise concerned in their formation.

In addition to the description of these bones, in the account of the bones of the head, it will be useful to study the description of the cavities of the nose which follows it, (see page 122.)

After thus acquiring a knowledge of the bony structure, the student will be prepared for a description of the softer parts.

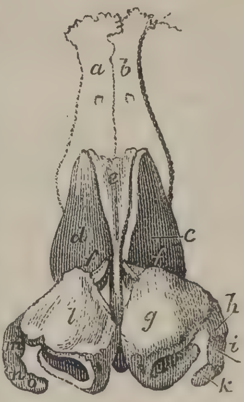
Of the External Nose.

The superior part of the nose is formed by the ossa nasi, and the nasal processes of the upper maxillary bones, which have been already described, (see pages 86–89); but the inferior part, which is composed principally of cartilages, is much more complex in its structure.

The orifice, formed by the upper maxillary and nasal bones, is divided by a cartilaginous plate, which is the anterior and inferior part of the septum, or partition between the two cavities of the nose. The anterior edge of this plate projects beyond the orifice in the bones, and continues in the direction of the

suture between the ossa nasi. This edge forms an angle with the lower edge of the same cartilage, which continues from it in a horizontal direction, until it reaches the lower part of the orifice of the nose, at the junction of the palatine processes of the upper maxillary bones; where a bony prominence is formed, to which it is firmly united. The upper part of the anterior edge of this cartilage, which is in contact with the ossa nasi, is flat, and is continued into two lateral portions that are extended from it one on each side, and form a part of the nose: these lateral portions are sometimes spoken of as distinct cartilages, *(superior lateral,)* but they are really continuations of the middle portion or septum.

Fig. 116.*



Below the lower edge of these lateral portions are situated the fibro cartilages which form the orifices of the nose, or the nostrils. Of these, there is one of considerable size, *(inferior lateral,)* and several small fragments, on each side of the septum. Each of the larger cartilages forms a portion of an oval ring, which is placed obliquely on the side of the septum: so that the extremity of the oval points downward and forward, while the middle part of the oval is directed upwards and backwards. The sides of this cartilage are flat, and unequal in breadth. The narrowest side is internal, and projects lower down than the cartilaginous septum; so that it is applied to its fellow of the other nostril. The external side is broader, and continues backward and upward to a considerable distance.

* Fig. 116.—*a, b,* Ossa nasi, which show above, the serrated surface by which they are united to the os frontis. *c, d,* Superior lateral cartilage. *e,* Vertical cartilaginous septum of the nose. *f, f,* Sesamoid cartilages, filling up part of the vacuity here. *g, l,* Oval or *inferior lateral* cartilages, or cartilages of the alæ nasi; below they are thin and curved so as to form the arch of the anterior nares. *h, i, k,* Small square cartilages appended to the alæ nasi and circumscribing the outer and back part of the nostrils. *m, n, o,* Same parts of the right side.

The upper and posterior part of this oval ring is deficient; but the remainder of the nostril consists of several small pieces of cartilage, *(cartilages carrès,)* which are fixed in a ligamentous membrane that is connected by each of its extremities to the oval cartilage, and thus completes the orifice.

The anterior parts of the oval cartilage form the point of the nose; and the ligamentous portions, the alæ or lateral parts of the nostrils.

When the external integuments and muscles are removed from the lower portion of the nose, so that the internal membrane and these cartilages only remain, the internal membrane will be found attached to the whole bony margin of each orifice, and to each side of the whole anterior edge of the middle cartilage, which projects beyond the bones. This membrane is afterwards continued so as to line the oval cartilages and the elastic membrane of the ala nasi, to the margin of the orifice of the nostril.

The internal portions of the oval cartilages being situated without the septum, and applied to each other, they form the external edge of the partition between the nostrils, or the columna nasi; which is very movable upon the edge of the middle cartilage.

The orifices of the nostrils, thus constructed, are dilated by that portion of the muscle, called *Levator Labii Superioris Alæque Nasi,* which is inserted into the alæ nasi.

They are drawn down by the depressor labii superioris alæque nasi. They are pressed against the septum and the nose by the muscle called *Compressor Naris,* which has however an opposite effect when its upper extremity is drawn upwards by those fibres of the occipito frontalis, which descend upon the nose, and are in contact with it.

The end of the nose is also occasionally drawn down, by some muscular fibres which descend from it, on the septum of the nose, to the orbicularis oris: they are considered as a portion of this muscle by many anatomists, but were described by Albinus as a separate muscle, and called *Nasalis Labii Superioris.*

When inspiration takes place with great force, the alæ nasi would be pressed against the septum, if they were not drawn out and dilated by some of the muscles above mentioned.

Of the Cavities of the Nose.

To the description of the osseous parts of the nasal cavities in page 89, it ought now to be added, that the vacuity in the anterior part of the osseous septum is filled up by a cartilaginous plate, connected with the nasal lamella of the ethmoid bone above, and with the vomer below. This plate sends off those lateral portions already described, which form the cartilaginous part of the bridge of the nose.

It should also be observed that at the back parts of these cavities are two orifices called the *Posterior Nares*, (see fig. 117, p. 456,) which are formed by the palate bones, the vomer, and the body of the sphenoidal bone, and are somewhat oval.

The nasal cavities, thus constructed, are lined by a peculiar membrane, which is called *pituitary* from its secretion of mucus, or *Schneiderian* after the anatomist who described it with accuracy.*

This membrane is very thick and strong, and abounds with so many blood-vessels, that in the living subject it is of a red colour. It adheres to the bones and septum of the nose like the periosteum, but separates from them more easily. The surface which adheres to the bones has some resemblance to periosteum, while the other surface is soft, spongy, and rather villous. Bichat seems to have considered this membrane as formed of two lamina, viz. periosteum, and the proper mucous membrane; but he adds, that it is almost impossible to separate them.

It has been supposed that many distinct glandular bodies were to be seen in the structure of this membrane by examining the surface next to the bones;† but this opinion is adopted

* Conrad Schneider, a German professor, in a large work, "De Catarrhis," published about 1660.

† See Winslow, Section X. No. 337.

by very few of the anatomists of the present day. The texture of the membrane appears to be uniform ; and on its surface are a great number of follicles of various sizes, from which flows the mucus of the nose.

These follicles appear like pits, made by pushing a pin obliquely into a surface which retains the form of the impression. They can be seen very distinctly with a common magnifying glass when the membrane is immersed in water, both on the septum and on the opposite surface. They are scattered over the membrane without order or regularity, except that in a few places they occur so as to form lines of various lengths, from half an inch to an inch. The largest of them are in the lower parts of the cavities.

—The surface of this membrane when examined with the microscope, is found to be furnished with the ciliary epithelium, consisting of minute projections or columns, thickly set with fine cilia or fringes, which have a peculiar vibratile motion of their own for carrying on fluids, not well understood.—

It may be presumed that the secretion of mucus is effected here by vessels which are mere continuations of arteries spread upon a surface analogous to the exhalents, and not convoluted in circumscribed masses, as in the case of ordinary glands.

The arteries of this membrane are derived from various sources : the most important of them is the nasal branch of the internal maxillary, which passes into the nose through the spheno-palatine foramen, and is therefore called the *Spheno-palatine Artery.* It divides into several twigs, which are spent upon the different parts of the surface of the nasal cavities. Two of them are generally found on the septum of the nose : one, which is small, passes forwards near the middle ; the other, which is much larger, is near the lower part of it.

Two small arteries, called the *anterior and posterior ethmoidals,* which are branches of the ophthalmic, enter the nose by foramina of the cribriform plate of the ethmoidal bone. These arteries pass from the orbit to the cavity of the cranium, and then through the cribriform plate to the nose. In addition to these, there are some small arteries derived from the infra-

orbital, the alveolar and the palatine, which extend to the Schneiderian membrane; but they are not of much importance.

The veins of the nose correspond with the arteries. Those which accompany the ethmoidal arteries open into the ocular vein of the orbit, which terminates in the cavernous sinuses of the head. The other veins ultimately terminate in the external jugulars.

The nerves of the nose form an important part of the structure; they are derived from several sources; but the most important branches are those of the olfactory.

The olfactory nerves form oblong bulbs, which lie on each side of the crista gilli, on the depressed portions of the cribriform plate of the ethmoid bone, within the dura mater. These bulbs are of a soft consistence, and resemble the cortical part of the brain mixed with streaks of medullary matter. They send off numerous filaments, which pass through the foramina of the ethmoid bone, and receive a coat from the dura mater as they pass through it.

These filaments are so arranged that they form two rows, one running near to the septum, and the other to the surface of the cellular part of the ethmoid bone, and the os turbinatum: and in addition to these are some intermediate filaments.

When the Schneiderian membrane is peeled from the bones to which it is attached, these nervous filaments are seen passing from the foramina of the ethmoid bone to the attached surfaces: one row passing upon that which covered the septum, and the other to that of the opposite side; while the intermediate filaments take an anterior direction, but unite to the membrane as soon as they come in contact with it.

All of these can be traced downwards on the aforesaid surfaces of the membrane for a considerable distance, when they gradually sink into the substance of the membrane, and most probably terminate on the internal villous surface; but they have not been traced to their ultimate termination. They ramify so that the branches form very acute angles with each other. On the septum the different branches are arranged so as to form

brushes, which lie in contact with each other. On the opposite sides, the different ramifications unite, so as to form a plexus.

Dr. Soemmering has published some very elegant engravings of the nose, representing one of his dissections, which appears to have been uncommonly minute and successful.* These represent the ramifications as becoming more expanded and delicate in the progress towards their terminations, and as observing a tortuous course, with very short meandering flexures.

It is to be observed that the ramifications of the olfactory nerve, thus arranged, do not extend to the bottom of the cavity. On the external side, they are not traced lower than the lower edge of the ethmoid, or of the superior spongy bone: and on the septum, they do not extend to the bottom, although they are lower than the opposite side. On the parts of the membrane not occupied by the branches of the olfactory nerves, several other nerves can be traced. The nasal twig of the ophthalmic branch of the fifth pair, after passing from the orbit into the cavity of the cranium, proceeds to the nasal cavity on each side by a foramen of the cribriform plate; and after sending off some fibrillæ, descends upon the anterior part of the septum to the point of the nose. The spheno-palatine nerve, which is derived from the second branch of the fifth pair, and enters the nose by the spheno-palatine foramen, is spread upon the lower part of the septum and of the opposite side of the nose also, and transmits a branch through a canal in the foramen incisivum to the mouth. Several small branches also pass to the nose from the palatine and other nerves; but those already mentioned are the most important.

A question has been proposed, whether the olfactory nerve is exclusively concerned in the function of smelling, or whether the other nerves above mentioned are also concerned in it. It seems probable that this function is exclusively performed by the olfactory nerve, and that the other nerves are like the ophthalmic branch of the fifth pair, with respect to the optic

* They are entitled, Icones Organorum Humanorum Olfactus.

nerve. In proof of this, it is asserted that the sense of smelling has entirely ceased in some cases, where the sensibility to mechanical irritation of every kind has remained unchanged. If the olfactory nerve alone is concerned in the function of smelling, it follows, that this function must be confined to the upper parts of the nasal cavities; but it ought to be remembered, that the structure of the Schneiderian membrane, in the lower parts of these cavities, appears exactly like that which is above.

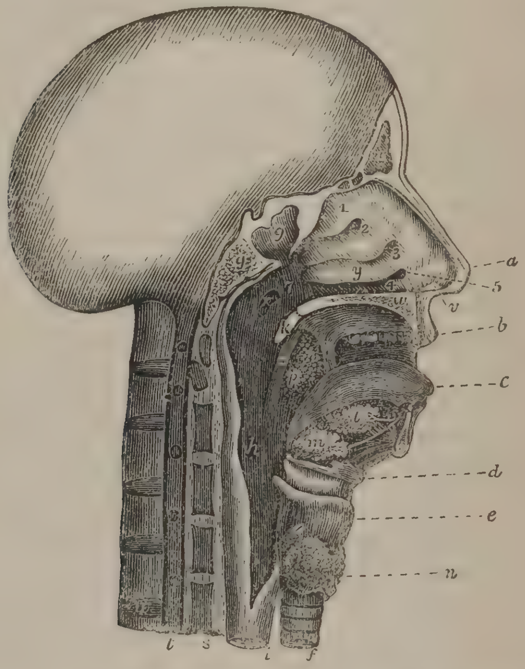
The surface of the nasal cavities and their septum, when covered with the Schneiderian membrane, correspond with the osseous surface formerly described. The membrane covers the bones and cartilage of the septum, so as to make one uniform regular surface. From the upper part of the septum, it is continued to the under side of the cribriform plate of the ethmoid, and lines it; the filaments of the olfactory nerve passing through the foramina of that bone into the fibrous surface of the membrane. It is continued from the septum, and from the cribriform plate, to the internal surface of the external nose, and lines it. It is also continued backwards to the anterior surface of the body of the sphenoidal bone; and, passing through the foramina or openings of the sphenoidal cells, it lines these cavities completely; but in these, as well as the other cavities, its structure appears somewhat changed; it becomes thinner and less vascular.

At the above mentioned foramina, in some subjects, it forms a plate or fold, which diminishes the aperture considerably.

From the upper surface of the nasal cavities, the membrane is continued downwards over the surface opposite to the septum. On the upper flat surfaces of the cellular portions of the ethmoid, it forms a smooth uniform surface. After passing over the first turbinated bone, or that called after Morgagni, it is reflected into the groove, or upper meatus immediately within and under it; the fold formed by the membrane, as it is reflected into the meatus, is rather larger than the bone: and the edge of the fold therefore extends lower down than the edge of the bone, and partly covers the meatus like a flap, consisting

only of the double membrane. This fold generally continues backwards as far as the spheno-maxillary foramen, which it closes; the periosteum, exterior to the foramen, passing through it, and blending itself with the fibrous surface of the Schneide-

Fig. 117.*



* Fig. 117—is a vertical section, exhibiting a profile view from the inside of the cavities of the nostrils, mouth, and pharynx. *a*, The nose. *b*, Upper lip, situated in front of the palatine arch, which runs horizontally backwards, and divides the cavity of the mouth from the nasal fossæ. *c*, The tongue, the base of which is attached to the os hyoides *d*. *e*, The larynx, suspended from the os hyoides, by the thyreo-hoid ligaments which are seen intervening; it opens backwards towards the pharynx. *f*, Trachea. *g*, Cuneiform process of the occipital bone, united to the body of the sphenoid, and to which is chiefly suspended the pharynx *h*, which is laid open (in order to show its shape and position) by the removal of its right half, and is seen terminating below opposite the cricoid cartilage in the œsophagus. *i*, Commencement of the œsophagus. *k*, Section of the velum pendulum palatæ, the lower point of which constitutes the uvula; above this is seen the opening of the posterior nares, 7, into the top part of the cavity of the pharynx; below this are seen the two half arches of the palate. *o*, Posterior half arch. *r*, Anterior half arch, the space or

rian membrane within. Here the spheno-palatine nerves and arteries join the membrane. Below this meatus, it extends over the middle, (formerly called the upper,) turbinated bone, and is reflected or folded inwards on the under side of this bone, and continued into the middle meatus below it. In the middle meatus, which is partly covered by the last mentioned turbinated bone, there are two foramina; one communicating with the maxillary sinus, and the other with the anterior cells of the ethmoid and the frontal sinuses. The aperture into the maxillary sinuses is much less in the recent head, in which the Schneiderian membrane lines the nose, than it is in the bare bones. A portion of the aperture in the bones is closed by the Schneiderian membrane, which is extended over it: the remainder of the aperture is unclosed; and through this foramen, the membrane is reflected so as to line the whole cavity. As a portion of the foramen is covered by the membrane, and this portion, as well as the other parts of the cavity, is lined by the membrane, it is obvious that at the place where the membrane is extended over the foramen in the bone, it must be doubled; or, in other words, a part of the aperture of the maxillary sinus is closed by a fold of the Schneiderian membrane.*

This aperture varies in size in different subjects, and is often equal in diameter to a common quill. It is situated in the

cavity between these occupied by the tonsil gland or amygdala *p*. *l*, Sublingual gland, placed under the tongue, and communicating with the mouth by a small duct, (*ductus Bartholinus:*) many small ducts from this gland, open into the duct of the gland below. *m*, Sub-maxillary gland, situated below and behind the preceding gland. *n*, Thyroid gland. *s*, Vertical section of the border of the cervical vertebræ, to which the pharynx is attached by cellular tissue. *t*, Spinal canal. *u*, Section of spinous processes and muscles of the neck. *v*, Left nostril. *w*, Bony palate. *x*, Trumpet-shaped orifice of the Eustachian tube. *y*, Inferior turbinated bone, covered by the Schneiderian membrane. *z*, Middle turbinated bone. 1 Superior turbinated bone, both covered with the same membrane. 2, Superior meatus. 3, Middle meatus. 4, Inferior meatus. 5, Place of opening of the ductus ad nasum. 6, Frontal sinuses. 7, The posterior nares. 8, Sphenoidal cell in the body of the sphenoid bone, showing the orifice below, by which it communicates with the top of the pharynx; above is seen the sella turcica of the sphenoid bone.

* In the mucous membrane lining the cavities of the maxillary, sphenoid and ethmoid bones, no one has yet detected any mucous follicles. The pouch formed by the reflection of the membrane, seems itself to constitute a large follicle, from which mucus is abundantly secreted.—P.

middle of the meatus, and is covered by the middle turbinated bone immediately above it,—a prominence of the cellular structure of the ethmoid bone, which has a curved or semicircular figure. Near this prominence, in the same meatus, a groove terminates, which leads from the anterior ethmoid cells and the frontal sinuses.

From the middle meatus, the membrane proceeds over the inferior turbinated bone, and is reflected round and under it into the lower meatus. It appears rather larger than the bone which it covers; and therefore the lower edge of the bone does not extend so low as the lower edge of the membrane, which of course is like a fold or plait. The membrane then continues and lines the lower meatus: here it appears less full than it is in the turbinated bone. In this meatus, near to its anterior end, is the lower orifice of the lachrymal duct; this is simply lined by the Schneiderian membrane, which is continued into it, and forms no plaits or folds that effect the orifice.

Orifice of the Eustachian Tube.

Immediately behind each of the nasal cavities, on the external side, is the orifice of the *Eustachian Tube.* It has an oval form, and is large enough to admit a very large quill. Its position is oblique: the upper extremity being anterior to the other parts of the aperture, and on a line with the middle meatus, while the centre is behind the inferior turbinated bone. The lower part of the oval is deficient. This tube is formed posteriorly by a cartilaginous plate. It is lined by the membrane continued from the nose.

The cavities of the nose answer a twofold purpose in the animal economy; they afford a surface for the expansion of the olfactory nerves, and a passage for the external air to the windpipe, in respiration.

The function of smelling appears to be dependent, to a certain degree, upon respiration. It has been asserted that unless the air passes in a stream through the nose, as in respiration, the perception of odour does not take place; that in persons who breathe through wounds and apertures in the windpipe, the function of smelling is not performed. It is rather in confirmation of this proposition, that most persons, when they wish to have an accurate perception of any odour, draw in air rapidly through the nose.

Although the ultimate terminations of the olfactory nerves cannot be demonstrated like those of the optic and auditory nerves, it is probable, from the appearance of

the fibres, while they are distinguishable, that they are finally arranged with great delicacy. It is certain that the impressions from whence we derive the perceptions of many odours must be very slight, as some odorous bodies will impregnate the air of a large chamber for a great length of time, without losing any sensible weight.

With respect to delicacy of structure and sensibility, it is probable that the nose holds a middle rank between the eye or ear, and the tongue: and on this account the mucus is necessary as a covering and defence of its surface.

It has been ascertained, by the investigations of chemists, that this mucus contains the same ingredients as the tears already described, namely, animal mucus and water; and muriate of soda, and soda uncombined; phosphate of lime, and phosphate of soda.

The animal mucus, which is a most important ingredient in the composition, resembles the mucilage formed by some of the vegetable gums in several particulars; and differs from them in others.

The mucus of the nose, if it remain there long after it is secreted, becomes much more viscid in consistence, and changes from a whitish colour to one which partakes more or less of the yellow. It is probable than an incipient putrefaction may occasion these changes in it.

The use of the frontal, maxillary and other sinuses, communicating with the nose, has been the subject of some inquiry. As there can be no stream of air through them, and as the membrane lining them is neither so thick, villous nor flexible as that lining the nose, it may be concluded, a priori, that they are not concerned in the function of smelling. This opinion is strengthened by the fact, that very young children, in whom these sinuses scarcely exist, enjoy the sense of smelling in perfection. The following fact is also in support of it. The celebrated Desault attended a patient, in whom one of the frontal sinuses was laid open by the destruction of the bone which covered it anteriorly. This patient was able to breathe a short time through the sinus when the mouth and nose were closed: at the request of Desault he breathed in this manner when a cup of some aromatic liquor was held near the opening of the sinus, and had not the least perception of odour. This experiment was repeated several times.

Many physiologists believe that these sinuses have an effect in modulating the voice.

CHAPTER XIII.

OF THE MOUTH.

The general cavity of the mouth is formed anteriorly and laterally by the connexion of the lips and cheeks to the upper and lower jaws; so that the teeth and the alveoli of both jaws may be considered as within the cavity. Above, it is bounded principally by the palatine processes of the upper maxillary and palate bones, and the soft palate, which continues backward from them in the same direction.

Below, the cavity is completed by several muscles, which proceed from almost the whole internal circumference of the lower jaw, and, by their connexions with each other, with the tongue and the os hyoides, form a floor or bottom to it. The tongue is particularly connected to this surface, and may be considered as resting upon and supported by it.

To acquire an idea of the parietes of this cavity, after studying the upper and lower maxillary bones, the orbicularis oris and the muscles connected with it, especially the buccinator, ought to be examined; and also the diagastricus, the mylo-hyoideus, genio-hyoideus, and genio-hyoglossus. By this it will appear that the lips and cheeks, and the basis or floor of the mouth, are formed in a great measure by muscles. Upon the internal surface of these muscles, a portion of cellular and adipose substance is arranged, as well as glandular bodies of different sizes; and to these is attached the membrane which lines the inside of the mouth.

This membrane passes from the skin of the face to the lips, and the inside of the mouth; and, although it is really a continuation of the skin, there is so great a change of structure that it ought to be considered as a different membrane. At the orifice of the lips it is extremely thin, and so vascular, that it

produces the fine florid colour which appears there in health. It is covered by a cuticle, called by some anatomists, *Epithelium,* which has a proportionate degree of delicacy, and can be separated like the cuticle in other parts. When this cuticle is separated, the lips and the membrane of the mouth appear to be covered with very fine villi, which are particularly apparent in some preparations of the lips after injection and maceration.*

Under this membrane are many small glandular bodies of a roundish form, called glandulæ labiales, whose excretory ducts pass through it to the inner surface of the mouth, for the purpose of lubrifying it with their secretion, which is mingled with the saliva.

The membrane which lines the inside of the lips and cheeks, is somewhat different from that which forms the surface of the orifice of the mouth: it is not so florid; the blood-vessels in its texture are larger, and not so numerous. This change, however, takes place very gradually, in the progress of the membrane, from the orifice of the lips to the back part of the cheeks. Glandular bodies, like those of the lips, are situated immediately exterior to this membrane of the cheeks, between it and the muscles: their ducts open on its surface. These glands are called *Buccales.*

This lining membrane is continued from the internal surface of the lips and cheeks to the alveolar portions of the upper and lower jaws, which are in the cavity of the mouth, and covers them, adhering firmly to the periosteum.

The teeth appear to have passed through apertures in this membrane, and are surrounded by it closely at their respective necks.

The portion of membrane, which thus invests the jaws, constitutes the *gums;* which have now acquired a texture very different from that of the membrane from which they were continued. They are extremely firm and dense, and very vascular. It is probable that their ultimate structure is not perfectly understood.

* Ruysch had a fine preparation of this structure. See Thesaurus VII. Tab. III. Fig. 5.

In the disease called *scurvy*, they tumefy and lose the firmness of their texture: they acquire a livid colour, and are much disposed to hemorrhage.

From the alveoli of the upper jaw, the lining membrane is continued upon the palatine processes of the upper maxillary and palate bones, or the roof of the mouth.

The membrane of the palate is not quite so firm as that of the gums, and is also less florid: it adheres firmly to the periosteum, and thus is closely fixed to the bones. There is generally a ridge on its surface, immediately under the suture between the two upper maxillary bones; and some transverse ridges are also to be seen upon it. On the internal surface of this membrane, are small glandular bodies, whose ducts open on the surface of the palate.

It is asserted, that this membrane has a limited degree of that sensibility which is essential to the functions of tasting; and that if certain sapid substances are carefully applied to it, their respective tastes will be perceived, although they have not been in contact with the tongue.

The membrane is continued from the bones above mentioned to the soft palate, or velum pendulum palati, which is situated immediately behind them. This soft palate may be considered as a continuation of the partition between the nose and mouth; it is attached to the posterior edge of the palatine processes of the ossa palati, and to the pterygoid processes of the sphenoidal bone. Its interior structure is muscular. The upper surface is covered by the membrane of the nose, the lower surface by the membrane which lines the mouth.

The muscles, which contribute to the composition of this structure, are the circumflexi and the levatores palatii above, and the constrictores isthmi faucium and palato-pharyngei below. (See pages 318, 319.) Thus composed, the soft palate constitutes the back part of the partition between the nose and mouth. When viewed from before, with the mouth open, it presents towards the tongue an arched surface, which continues downwards on each side, until it comes nearly in contact with the edges of that organ. On each of the lateral parts of this

arch, are two pillars, or rather prominent ridges, which project into the mouth. These ridges are at some distance from each other below, and approach much nearer above, so that they include a triangular space. They are called the *lateral half arches* of the palate, (see fig. 117, p. 455.) Each of them is formed by a plate or fold of the lining membrane of the mouth, and contains one of the two last mentioned muscles; the anterior, the constrictor isthmii faucium; the posterior, the palato-pharyngeus. These muscles, of course, draw the palate down toward the tongue when they contract.

From the centre of the arch, near its posterior edge, is suspended the uvula, a conical body, which varies in length from less than half an inch, to rather more than one inch. It is connected by its basis to the palate; but its apex is loose and pendulous. This body is covered by the lining membrane of the mouth. It contains many small glands, and a muscle also, the azygos uvulæ, which arises from the posterior edge of the ossa palati, at the suture which connects them to each other, and, passing posteriorly upon the soft palate, extends from the basis to the apex of the uvula, into which it is inserted. By the action of this muscle, the length of the uvula can be very much diminished: and when its contraction ceases, that body is elongated.*

The pendulous part of the uvula can also be moved, in certain cases, to either side.

It is commonly supposed, that the principal use of this little organ is to modulate the voice; but there are good reasons for believing, that it has another object. It was remarked by Fallopius, (and the observation has been confirmed by many surgeons since his time,) that the uvula may be removed completely without occasioning any alteration of the voice, or any difficulty of deglutition, if the soft palate be left entire.

The soft palate is so flexible, that it yields to the actions of the levatores palati, which draw it up so as to close the posterior nares completely.

* A careful dissection, shows two of these muscles.—P.

It also yields to the circumflexi or tensores, which stretch it so as to do away its arched appearance.

It is therefore very properly called the *Palatum Molle*, or *soft palate*. It is also frequently called the *Velum Pendulum Palati*, from the position which it assumes.

The Tongue,

which is a very important part of this structure, is retained in its position and connected with the parts adjoining it, by the following arrangements.

The os hyoides, which, as its name imports, resembles the Greek letter υ, or half an oval, is situated rather below the angles of the lower jaw, in the middle of the upper part of the neck. It is retained in its position by the sterno-hyoidei muscles, which connect it to the upper part of the sternum, by the coraco, or omo-hyoidei, which pass to it obliquely from the scapula; by the thyro-hyoidei, which pass to it directly upward from the thyroid cartilage, all of which connect it to parts below. To these should be added the stylo-hyoidei, which pass to it obliquely from behind and rather from above: the mylo-hyoidei, which come rather anteriorly from the lateral parts of the lower jaw; and the genio-hyoidei, which arises from a situation directly anterior and superior to the chin. When these muscles are at rest, the situation of the os hyoides is, as above described, below the angles of the lower jaw: when those, in one particular direction act, while the others are passive, the bone may be moved upwards or downwards, backwards or forwards, or to either side. This bone may be considered as the basis of the tongue; for the posterior extremity of that organ is attached to it, and of course the movements of the bone must have an immediate effect upon those of the tongue.

The tongue is a flat body of an oval figure, but subject to considerable changes of form.

The posterior extremity, connected to the os hyoides, is commonly called its base; the anterior extremity, which, when the tongue is quiescent, is rather more acute, is called its apex.

The lower surface of the tongue is connected with a number

of muscles, which are continued into its substance. This connexion is such, that the edges of the tongue are perfectly free and unconnected; and so is the anterior extremity for a considerable distance from the apex towards the base.

The substance of the tongue consists principally of muscular fibres intermixed with a delicate adipose substance. It is connected to the os hyoides by the hyo-glossus muscle, and also by some other muscular fibres, as well as by a dense membranous substance, which appears to perform the part of a ligament. This connexion is also strengthened by the continuance of the integuments from the tongue to the epiglottis cartilage, to be hereafter described; for that cartilage is attached by ligaments to the os hyoides.

The tongue is thin at its commencement at the os hyoides; but it soon increases in thickness. The muscular fibres in its composition have been considered as intrinsic, or belonging wholly to its internal structure; and extrinsic, or existing in part outside of this structure. The lingualis muscles are intrinsic (see page 316): they are situated near the under surface of the tongue, one on each side, separated from each other by the genio-hyo-glossi muscles, and extending from the basis of the tongue to its apex. These muscles can be easily traced as above described: but there are also many fibres in the structure of the tongue, which seem to pass in every direction, and of course are different from those of the linguales muscles. To these two sets of fibres are owing many of the immensely varied motions of the different parts of the tongue.

—According to Gerdy, (whose researches on this subject have been approved by Ribes and Breschet,) the structure of the tongue consists of the mucous membrane forming its outer coat, of a peculiar *yellow lingual tissue* which forms the ligament by which it is attached to the os hyoides and is extended along the middle line of the tongue to form a sort of raphe for the attachment of the transverse muscular fibres, and of the intrinsic and extrinsic muscles; it is mixed up with some delicate cellular and adipose tissue. The intrinsic muscles consist, 1st, of a superficial lingual muscle; 2d, of two deep-seated, all of

which are longitudinal; 3d, of transverse muscular fibres, reunited at the raphe, in the middle line of the tongue; 4th, of some vertical fibres which are inserted on the lower surface of the mucous membrane. The ligament from the os hyoides extended along the middle line of the tongue, Blandin calls the lingual cartilage. The evidence in favour of its cartilaginous nature, is not very satisfactory in man. The epidermis of the tongue, which is much thicker than that of other portions of the mouth, forms, according to Blandin, a sheath open at top, round the sensitive papillæ, which protects them when the tongue acts as an instrument of mastication, and through which the papillæ protrude, to come fully in contact with the sapid substance when tumefied or erected by the gustatory excitement.—

In addition to these, are the extrinsic muscles, which originate from the neighbouring parts, and are inserted and continued into the substance of the tongue. See fig. 121.

Among the most important of the muscles, are those which proceed from the chin, or the genio-hyo-glossi. They are in contact with each other; their fibres radiate from a central point on the inside of the chin, and are inserted into the middle of the lower surface of the tongue: the insertion commencing at a short distance from its apex, and continuing to its base.

As the genio-hyo-glossi muscles have a considerable degree of thickness, they add much to the bulk of the tongue in the middle of the posterior parts of it.

The hyo-glossi and the stylo-glossi, being continued into the posterior and lateral parts, contribute also to the bulk of these parts.

The tongue, thus composed and connected, lies, when at rest, on the mylo-hyoidei muscles; and the space between it and these muscles is divided into two lateral parts by the above described genio-hyo-glossi. In the space above mentioned, is a small salivary gland, of an irregular oval form; the greatest diameter of which extends from before backwards, and its edges present outwards and inwards. It has several excretory ducts, the orifices of which form a line on each side of the tongue. This gland is very prominent under the tongue; and

when the tongue is raised it is particularly conspicuous: it is called the *Sublingual.*

The lining membrane of the mouth continues from the inside of the alveoli of the lower jaw, which it covers, over the sublingual glands to the lower surface of the tongue. In this situation it is remarkably thin; but, as it proceeds to the upper surface of the tongue, its texture changes considerably, and on this surface it constitutes the organ of taste.

The upper surface of the tongue, although it is continued from the thin membrane above described, is formed by a rough integument which consists, like the skin, of three lamina. The cuticle is very thin; and under it, the rete mucosum* is thicker and softer than in other places.

The true skin here abounds with eminences of various sizes and forms, all of which are denominated *Papillæ.* The largest of these are situated on the posterior part of the tongue, and are so arranged that they form an angle rather acute, with its point backwards. They are commonly nine in number: they resemble an inverted cone, or are larger at their head than their basis. They are situated in pits or depressions, to the bottoms of which they are connected. In many of them there are follicles, or perforations, which have occasioned them to be regarded as glands. They are called *Papillæ Maximæ,* or *Capitatæ.*

The papillæ, next in size, are denominated *fungiform* by some anatomists, and *Mediæ,* or *Semilenticulares* by others. They are nearly cylindrical in form, with their upper extremities regularly rounded. They are scattered over the upper surface of the tongue, in almost every part of it, at irregular distances from each other.

The third class are called *conoidal* or *villous.* They are very numerous, and occupy the greatest part of the surface of the tongue. Although they are called *conoidal,* there is a great

* M. Bichat appears to have had doubts whether the real rete mucosum existed here. He says that he could only perceive a decussation of vessels in the intervals of the papillæ, which, as he supposes, occasioned the florid colour of the tongue.

difference in their form; many of them being irregularly angular and serrated as well as conical.

Soemmering and other German anatomists consider the smallest papillæ as a fourth class, which they call the *filiform*: these lie between the others.

It is probable that these papillæ are essential parts of the organ of taste; and their structure is of course an interesting object of inquiry.

The nerves of the tongue have been traced to the papillæ, and have been compared by some anatomists to the stalk of the apple, while the papillæ resembled the fruit; but their ultimate termination does not appear to have been ascertained.*

—The papillæ maximæ or capitatæ, are supplied, according to Cloquet, by filaments from the glosso-pharyngeal nerve, the fungiformes by filaments from the fifth. The papillæ maximæ appear to consist only of a collection of mucous follicles, which differ only from those of the soft palate and lips, by standing out more in relief.

—The follicles of each papilla open occasionally upon the side; several open by a common orifice at the top of the papilla, which is often very visible to the naked eye, as a little reddish point. Weber succeeded in injecting this orifice with mercury, and found it led to a central cavity irregularly divided by septæ into cells, visible to the naked eye, having some resemblance to, but much larger than those of the parotid. Other mucous follicles of a simpler kind are spread over the whole surface of the tongue between the smaller papillæ. Some are mere small pouches, opening by simple orifices, without canals. Others are more complicated, and according to Weber, who filled them with mercury, have ducts three or four lines in length, which run down between the muscular fibres of the

* In the explanation of the plates, referred to in the following sentence, Soemmering observes, that when the fibrillæ of the lingual nerve of the fifth pair are traced to the papillæ of the second class, they swell out into a conical form; and these nervous cones are in such close contact with each other, that the point of the finest needle could not be insinuated into the papillæ without touching a nerve.

tongue, to terminate in little flattened sacs divided into several cells, and having sometimes, a diameter of three lines.
—From all these follicles, comes that profusion of mucous secretion, which we see covering the tongue in diseases.
—He describes the sebaceous glands of the skin as being analagous in structure to these follicles, as well as those of the trachea and of the inside of the lips and cheeks.—

Soemmering has lately published some elegant engraved copies of drawings of these papillæ, when they were magnified twenty-five times; from which it appears that a very large number of vessels, particularly of arteries, exist in them. These vessels are arranged in a serpentine direction, and are prominent on the surface; but they appear doubled, and the most prominent part is the doubled end.—This arrangement of vessels is perceptible on the sides of the tongue, as well as on the papillæ.—

Behind the large papillæ is a foramen, first described by Morgagni, and called by him *Foramen Cœcum.* It is the orifice of a cavity which is not deep; the excretory ducts of several mucous glands open into it.

On the upper surface of the tongue, a groove is often to be seen, which is called the *linea mediana,* and divides it into two equal lateral parts.* Below, the lining membrane of the mouth, as it is continued from the lower jaw to the tongue, forms a plait, which acts as a ligament, and is called the *frænum linguæ.* It is attached to the middle of the tongue, at some distance behind the apex.

The tongue is well supplied with blood-vessels, which are derived from the *lingual branch* of the external carotid on each side. This artery passes from the external carotid, upwards, inwards, and forwards, to the body of the tongue. In this course it sends off several small arteries to the contiguous parts, and one which is spent about the epiglottis and the adjoining parts, called the *Dorsalis Linguæ.* About the anterior edge of the hyo-glossus muscle, it divides into two

* This groove indicates the position of the middle raphe of Gerdy.

large branches: one of which, called the *Sublingual*, passes under the tongue between the genio-hyo-glossus and the sublingual gland, and extends near to the symphysis of the upper jaw; sending branches to the sublingual gland, to the muscles under the tongue, to the skin, and the lower lip. The other is in the substance of the tongue, on the under side near the surface, and extends to the apex.

The veins of this organ are not so regular as the arteries: they communicate with the external jugular, and some of them are always very conspicuous under the tongue: these are called *ranular*.

It is to be observed, that the vessels on each side have but little connexion with each other; for those of one side may be injected while the others continue empty.

The tongue is also well supplied with nerves, and derives them from three different sources on each side, namely, from the fifth, the eighth, and ninth pairs of the head.

The lingual portion of the third branch of the fifth pair passing under the tongue, enters its substance about the middle, and forms many minute branches, which pass to the papillæ of the forepart of the tongue.

The glosso-pharyngeal portion of the eighth pair, sending off several branches in its course, passes to the tongue near its basis, and divides into many small branches, which are spent upon the sides and middle of the root of the tongue, and also upon the large papillæ.

The ninth pair of nerves are principally appropriated to the tongue. They pass on each side to the most fleshy part of it, and after sending one branch to the mylo-hyoideus, and another to communicate with the lingual branch of the fifth pair, they are spent principally upon the genio-glossi, and linguales muscles.

The tongue answers a threefold purpose. It is the principal organ of taste. It is a very important agent in the articulation of words, and it assists in those operations upon our food, which are performed in the mouth.

The Salivary Glands.

The salivary glands have such an intimate connexion with the mouth that they may be described with it.*

There are three principal glands on each side: the *Parotid*, *Submaxillary*, and the *Sublingual.* They are of a whitish or pale flesh colour, and are composed of many small united masses or lobuli, each of which sends a small excretory duct to join similar ducts from the other lobuli, and thereby form the great duct of the gland.

The *Parotid* is much larger than the other glands. It occupies a large portion of the vacuity between the mastoid process and the posterior parts of the lower jaw. It extends from the ear and the mastoid process over a portion of the masseter muscle, and from the zygoma to the basis of the lower jaw. Its name is supposed to be derived from two Greek words which signify contiguity to the ear. It is of a firm consistence. It receives branches from the external carotid artery and from its facial branch.

From the anterior edge of this gland, rather above the middle, the great duct proceeds anteriorly across the masseter muscle; and, after it has passed over, it bends inward through the adipose matter of the cheek to the buccinator muscle, which it perforates obliquely, and opens on the inside of the cheek opposite to the interval between the second and third molar teeth of the upper jaw. The aperture of the duct is rather less than the general diameter of it, and this circumstance has the effect of a valve. When the duct leaves the parotid, several small glandular bodies called sociæ parotidis, are often attached to it, and their ducts communicate with it. The main duct is sometimes called *ductus stenonianus*, after Steno, who first described it.

When the mouth is opened wide, as in gaping, there is often a jet of saliva from it into the mouth.

The parotid gland furnishes the largest proportion of saliva. It covers the nerve called *Portio Dura*, after it has emerged from the foramen stylo-mastoideum.

* For a further account of glands, see General Anatomy of Glandular System.

—This nerve after being covered a short distance by the gland, enters its substance, and forms there the plexus called *pes anserinus*, so as to leave a portion of the gland on the inner face of the nerve. The external carotid artery likewise traverses the gland and is situated rather more exteriorly than the nerve, so as to leave about one-third of the gland on its inner face. Branches from the artery are sent off in various directions as it traverses the gland, to the face, and to the structure of the gland itself.

—The duct of Steno, is very feebly attached to the surrounding parts, and is accompanied by many branches of the middle division of the facial nerves, and some small arteries which supply its walls ; it is covered only by the skin, some adipose tissue, by some fibres of the platysma myoides, and the zygomaticus major which crosses it obliquely. Its general diameter is about a line ; and it is very distensible. It will be found, according to the rule laid down by Dr. Physick, under a line drawn from the lobe of the ear, to the tip of the nose.

Fig. 118.

—The duct is composed of two coats, one, external, white, fibrous, and resisting ; the other, internal, is a mucous membrane, continuous with the lining membrane of the mouth, and appears to differ from it only in being paler.

—Fig. 118, is a microscopical representation of the structure of a portion of the parotid gland of a young infant, after it had been minutely injected with mercury from the duct of Steno, by E. H. Weber, of Leipzic. The small figure, to the right, is the natural size of the piece magnified, in which the salivary ducts were filled with the fluid to their very terminations. A branch of the salivary duct, is seen on the right margin of this figure, ramifying like the branch of a tree. These ramifications never anastomose together, and are of much greater size than the capillary blood-vessels. Each ramification, at its termination, resolves itself into cells densely compacted together, like a

bunch of grapes upon its stem, *a*, *a*, *a*. Some of the cells open by a minute excretory tube directly into the salivary duct. In other instances some of the ducts of the cells unite into a common tube, before entering the salivary duct. The cells are not round, and vary among themselves in regard to size.

—The average diameter of these cells, measured by a micrometer, were found by Weber, to be the $\frac{1}{1200}$th part of an inch, which he finds to be three times greater than that of the most delicate sanguineous vessels. The cellular structure of the parotid, seems therefore to be very analogous to the cellular structure of the lungs discovered by Soemmering and Reisseissen, the cells of the lungs, however, being five or six times larger than those of the parotid. The elaborate researches of Weber and Müller, have shown also that this is the common mode of termination of the excretory ducts in the different glands of the body; viz. that they terminate in closed cells, upon which ramify the delicate secretory capillary vessels.—

The second gland is called the *Submaxillary.* It is much smaller than the parotid, and rather round in form. It is situated immediately within the angle of the lower jaw, between it on the outside, and the tendon of the digastric muscle and the ninth pair of nerves internally. Its posterior extremity is connected by cellular membrane to the parotid gland; its anterior portion lies over a part of the mylo-hyoideus muscle; and from it proceeds the excretory duct, which is of considerable length, and passes between the mylo-hyoideus and genio-glossus muscles along the under and inner edge of the sublingual gland. In this course the duct is sometimes surrounded with small glandular bodies, which seem to be appendices to the sublingual gland. It terminates under the tongue, on the side of the frænum linguæ, by a small orifice which sometimes forms a papilla.* (See fig. 117, p. 454.)

* Lassus informs us that Oribases, afterwards all the Arabians, and subsequently Guy De Chauliac, Lanfranc, Achillini, Berenger De Carpi, Charles Etienne, Casserius and several others have given the description of these salivary ducts; notwithstanding which, Wharton, a physician of London, attributed to himself the discovery of them on the bullock, in 1656.—H.

The orifice is often smaller than the duct; in consequence of which, obstruction frequently occurs here, and produces the disease called *ranula.*

The *Sublingual gland*, which has already been mentioned, lies so that, when the tongue is turned up, it can be seen protruding into the cavity of the mouth, and covered by the lining membrane, which seems to keep it fixed in its place. It lies upon the mylo-hyoideus, by the side of the genio-hyoideus; and is rather oval in form, and flat. Its greatest length is from before backwards; its position is rather oblique, one edge being placed obliquely inwards and upwards, and the other outwards and downwards. It has many short excretory ducts, which open by orifices arranged in a line on each side: they are discovered with difficulty on account of their small size, and sometimes amount to eighteen or twenty in number. In some few instances, this gland sends off a single duct, which communicates with the duct of the submaxillary gland.

—The duct of the *Submaxillary* gland is called the duct of Wharton, *(ductus Whartonionus)* from an English anatomist who first described it. It is accompanied in nearly the whole of its course by the lingual branch of the fifth pair of nerves.

—The usual arrangement of the ducts of the sublingual gland is as follows: six or eight run from the upper part of the gland, to open by the side of the frænum linguæ. Five or six others proceed from its sides to open separately in the mucous membrane above the gland. Several open into the duct of Wharton which runs by the side of the gland; these most frequently unite to form a single duct, called the duct of Bartholinus, or duct of Rivinus. This I have frequently succeeded in distending with mercury from the duct of Wharton.

—The structure and office of these salivary glands appear the same, and not unfrequently a slight continuation of structure is observed at the two extremities of the submaxillary gland.—

The salivary fluid secreted by these glands is inodorous, insipid, and limpid, like water; but much more viscid, and of greater specific gravity. Water constitutes at least four-fifths

of its bulk ; and animal mucus one half of its solid contents. It also contains some albumen; and several saline substances ; as the muriate of soda, and the phosphates of lime, of soda, and of ammonia.

It is probable that this fluid possesses a solvent power with respect to the articles of food.

There are small glandular bodies, situated between the masseter and buccinator muscles, opposite to the last molar tooth of the upper jaw, whose nature is not well understood: they are called *Glandulæ molares.* They are believed to be mere mucous glands.

The motions of the tongue are very intelligible to a person who has a preparation of the lower jaw before him, with the tongue in its natural situation, and the muscles which influence it, properly dissected. Its complicated movements will appear the necessary result of the action of those muscles upon it, and the os hyoides; and also upon the larynx, with which the os hyoides is connected. The muscular fibres of the tongue itself are also to be taken into this view, as they act a very important part.

Although the tongue appears very necessary, in a mechanical point of view, to the articulation of many words, yet there are cases where it has been entirely deficient, in which the parties thus affected, have been able to speak very well in general, as well as to distinguish different tastes.*

The tongue is also a very delicate organ of touch.—We can perceive the form of the teeth, and the state of the surface of the mouth, more accurately by the application of the tongue than of the fingers.

On the three nerves which go to the tongue, it is generally supposed that the lingual portion of the third branch of the fifth pair is most immediately concerned in the function of tasting, as it passes to the front part of the surface of the tongue. The glosso-pharyngeal are probably concerned in the same function on the posterior part, while the ninth pair of nerves seems principally spent upon the muscular parts of the organ.

It is obvious that the tongue is most copiously supplied with nerves. This probably accounts for the great facility of its motions, and the power of continuing them.

* There is a very interesting paper on this subject, in the Memoirs of the Academy of Sciences for the year 1718, by *Jussieu;* in which he describes the case of a female fifteen years old, examined by himself, who was born without a tongue. In this paper he refers to another case, described by *Rolland*, a surgeon of Saumur, of a boy nine years old, whose tongue was destroyed by gangrene. In each of these cases the subject was able to articulate very well, with the exception of a few letters; and also enjoyed the sense of taste.

CHAPTER XIV.

OF THE THROAT.

To avoid circumlocution, the word *throat* is used as a general term to comprehend the structure which occurs behind the nose and mouth, and above the œsophagus and trachea. This structure consists,

1st. Of the parts immediately behind the mouth, which constitutes the *Isthmus* of the *Fauces:*

2d. Of the parts which form the orifice of the windpipe, or the *Larynx;*—and

3d. Of the muscular bag, which forms the cavity behind the nose and mouth, that terminates in the œsophagus or the *Pharynx.*

Of the Isthmus of the Fauces.

In the back part of the mouth, on each side, are to be seen the two ridges or half arches, passing from the soft palate to the root of the tongue, (see fig. 117, p. 454,) formed by plaits of the mucous membrane, containing muscular fibres. The anterior plait, which contains the muscle called *Constrictor Isthmi Faucium,* passes directly from the side of the root of the tongue to the palate, and terminates near the commencement of the uvula. The posterior plait runs from the palate obliquely downwards and backwards, as it contains the palato-pharyngeus muscle, which passes from the palate to the upper and posterior part of the thyroid cartilage.

In the triangular space between these ridges is situated a glandular body, called the *Tonsil* or *Amygdala.** This gland

* It is named amygdala, from its resemblance in form and appearance to an almond covered by its shell. The exterior or adhering surface of the tonsil gland is connected by the means of cellular tissue to the superior constrictor muscle of the pharynx.

The internal carotid artery is situated behind and to the outer side of the tonsil, and separated from it only by the constrictor muscle, and cellular tissue.

It has been wounded in opening abscesses of the tonsils, when the cutting instrument has been inclined too much outwards and backwards.—P.

has an oval form, its longest diameter extending from above downwards. Its surface is rather convex, its natural colour is a pale red. On its surface are the large orifices of many cells of considerable size, which exist throughout the gland. These cells often communicate with each other, so that a probe can be passed in at one orifice and out at the other.

Into these cells open many mucous ducts, which discharge in part the mucus of the throat, for the purpose of lubricating the surface, and facilitating the transmission of food.

—In its healthy state, the free surface of the tonsil glands, are a little below the level of the two half arches of each side. —But when their cells are distended by inflammation, or effaced by granulations, as in tonsillitis, they sometimes project beyond the half arches so as nearly or quite to meet in the middle line.—

The *Epiglottis*, or fifth cartilage of the larynx, is situated at the root of the tongue, in the middle, between the tonsils. The part which is in sight is partly oval in form, and of a whitish colour. Its position, as respects the tongue, is nearly perpendicular, and its anterior surface rather convex.

The mucous membrane continued from the tongue over the epiglottis is so arranged that it forms a plait, which extends from the middle of the root of the tongue along the middle of the anterior surface of the epiglottis, from its base upwards.

On each side of this plait or frænum, at the junction of the surfaces of the tongue and of the epiglottis there is often a depression, in which small portions of food sometimes remain; and a small frænum, similar to that above described, is sometimes seen on the outside of each of these cavities.

The epiglottis is situated immediately before the opening into the larynx.

The above described parts can be well ascertained in the living subject, by a person who has a general knowledge of the structure. Thus, looking into the mouth, with the tongue depressed, the uvula and soft palate are in full view above, and the epiglottis is very perceptible below; while the two ridges

or lateral half arches can be seen on each side, with the tonsil between them.

Of the Larynx.

—The larynx is situated immediately below the os hyoides, and is continuous at its inferior part with the trachea, to which it is attached, like a capital upon a column. It serves a double purpose; that of a tube for the introduction of air into the lungs; and that of a very complicated apparatus for the production of the voice.

—It is composed of cartilages which form its frame-work, ligaments and synovial capsules which unite the cartilages together, muscles to put them into motion, and an exquisitely sensitive mucous membrane, that lines the whole of its interior. It is larger and much more prominent in males than females, and undergoes a rapid and remarkable degree of developement, both in regard to size and energy of function at the period of puberty.—

In this structure are five cartilages, upon which its form and strength depends, namely, the *Cricoid*, the *Thyroid*, the two *Arytenoid*, and the *Epiglottis.* These cartilages are articulated to each other, and are supplied with muscles by which certain limited motions are effected.

The basis of the structure is a cartilaginous ring, called the *cricoid* cartilage, and which may be considered as the commencement of the windpipe.

It may be described as an irregular section of a tube: its lower edge connected with the windpipe, being nearly horizontal when the body is erect; and the upper edge very oblique, sloping from before, backwards and upwards; in consequence of this, it has but little depth, before, but is eight or nine lines deep behind.

—In front, and upon each side of the middle line there is a depression, in which arises the two crico-thyroid muscles. Upon each side, and near its upper and outer surface, there is a smooth convex facet, upon which is articulated, the corres-

ponding facet of the inferior cornua of the thyroid cartilage. Posteriorly are two slight vertical depressions, to which are attached the crico-arytenoidei postici muscles. Its internal face is covered by mucous membrane. Its superior border gives attachment in front to the crico-thyroid membrane, on the sides to the lateral crico-arytenoid muscles, and posteriorly presents a little notch, limited by two convex facets upon which are articulated the arytenoid cartilages.—

The *Thyroid* cartilage is a single plate, bent in such manner that it forms an acute angle with two similar broad surfaces on each side of it. It is so applied to the cricoid cartilage, that the lower edge of the angular part is at a small distance above the front part of that cartilage, and connected to it by ligamentous membrane; while its broad sides are applied to it laterally, and thus partially enclose it.

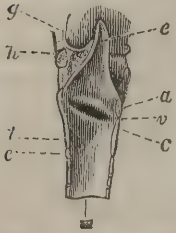
The upper edge of the angular part of the thyroid cartilage forms a notch; and the natural position of the cartilage is such, that this part is very prominent in the neck; it is called the *Pomum Adami.*

Both the upper and lower edges of the thyroid cartilage terminate posteriorly in processses, which are called *Cornua.* The two uppermost are longest: they are joined by ligaments to the extremities of the os hyoides. The lower and shorter processes are fixed to the cricoid cartilage. The thyroid cartilage, therefore, partly rests upon the cricoid cartilage below, and is attached to the os hyoides above. It is influenced by the muscles which act upon the os hyoides, and also by some muscles which are inserted into itself. It is moved obliquely downwards and forwards in a slight degree upon the cricoid cartilage, by a small muscle, the crico-thyroideus, which arises from that cartilage and is inserted into it.

—The external lateral surface of the thyroid cartilage is slightly concave, and across it, passes a small ridge obliquely from above downwards, and from behind forwards, which gives attachment above to the thyro-hyoid and below to the sterno-hyoid muscles. The posterior or inside face of the *Pomum Adami* presents an entering angle, where the two

symmetrical sides of the cartilage meet, and in which is attached the thyro-arytenoid muscles, the pedicle of the epiglottis and one end of the vocal ligaments. The upper margin of the cartilage presents a curved appearance like that of the italic long *ſ*; a similar curvature is also observable on its posterior margin.—

Fig. 119.*



The *Arytenoid* cartilages are two small bodies of a triangular or pyramidal form and slightly curved backward. They are placed upon the upper and posterior edge of the cricoid cartilage, near to each other; their upper ends, taken together, resemble the mouth of a pitcher or ewer; from which circumstance their name is derived. Their bases are broad; and on their lower surfaces is a cavity, which corresponds with the convex edge of the cricoid cartilage, to which they are applied. At these places, a regular movable articulation is formed, by a capsular ligament between each of these cartilages and the cricoid, in consequence of which they can be inclined backward or forward, inward or outward.

From the anterior part of each of these cartilages, near the base, a tendinous cord passes forward, in a direction which is horizontal when the body is erect, to the internal surface of the angle of the thyroid. These ligaments are not perfectly parallel to each other; they are nearer before than behind. The aperture between them is from two to five lines wide when the muscles are not in action; and this aperture† is the orifice of the windpipe: for the exterior space, between these ligaments and the circumference of the thyroid, is closed up by mem-

* Fig. 119. Vertical section of the larynx. *h*, Os hyoides. *t*, Thyroid cartilages. *c c*, Cricoid cartilage. *a*, Arytenoid cartilage. *v*, Ventricle of the larynx, bounded below by the ligamenta vocales, and above by the superior ligaments of the glottis. *e*, Epiglottis cartilage. *g*, Ligamentous attachment of the tongue to the os hyoides. *l*, Trachea cut off at the third ring. The lining membrane is left out in this section.

† It forms also the *rima glottidis* of the larynx.

brane and muscle. At a small distance above these ligaments are two others, which also pass from the arytenoid to the thyroid cartilages. They are not so tendinous and distinct as the first mentioned, and cannot be drawn so tense by the muscles of the arytenoid cartilages. They are also situated at a greater distance from each other, and thus form a large aperture.

On the external side of the upper extremity of each of the arytenoid cartilages, and nearly in contact with it, is a small cartilaginous body, not so large as a grain of wheat, and nearly oval in form. These are connected firmly to the arytenoid cartlages, and are called their *Appendices.** Being in the margin of the aperture of the larynx, they have an effect upon its form.

The arytenoid cartilages are the posterior parts of the larynx. The *Epiglottis*, which has already been mentioned is the anterior. When this cartilage is divested of its membrane, it is oval in its upper extremity, and rather angular below, terminating in a long narrow process, which is like the stalk of a leaf.

It is firmly attached to the internal surface of the angular part of the thyroid by this lower process; and, being placed in a perpendicular position, one of its broad surfaces is anterior—towards the tongue, and the other posterior—towards the opening of the windpipe.

It is attached to the os hyoides by dense cellular texture or ligament, and to the tongue by those plaits of the membrane of the mouth which have been already described.

It is elastic, but more flexible than the other cartilages; being somewhat different in its structure. Its surface is perforated by the orifices of many mucous ducts.

There is a small space between the lower part of this cartilage, and the upper part of the thyroid and the ligamentous membrane passing from it to the os hyoides. In this is a substance, which appears to consist of glandular and of adipose

* They are also called Cornicula Laryngis, Tubercles of Santorini.—P.

matter, (see fig. 119.) It is supposed that some of the orifices on the lower part of the epiglottis communicate with this substance.

—This substance is a collection of mucous glands, called *glandulæ epiglottidæ;* the ducts which arise from them are twenty or thirty in number, and perforate the epiglottis to throw their mucus on the side of the larynx.—

In the erect position of the body, the epiglottis is situated rather higher up than the arytenoid cartilages, and at the distance of ten or twelve lines from them.

The mucous membrane which covers the epiglottis, is reflected backwards from the base of the tongue, and is extended from each side of it to the arytenoid cartilages, and being continued into the cavity of the larynx, as well as upon the general surface of the throat, it is necessarily doubled: this doubling forms the lateral margins of the orifice of the cavity of the larynx. In these folds of the membrane are seen some very delicate muscular fibres, forming the *Aryteno-epiglottideus* muscle.

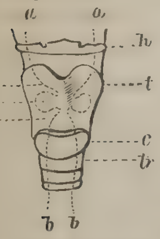
—The epiglottis maintains its vertical position, partly from its own elasticity of structure, and partly from the folds of mucous membrane, reflected to it from the tongue, which contain some yellow elastic ligamentous fibres.—

The membrane continues down the cavity of the larynx, and, covering the upper ligaments, penetrates into the vacuity between them and the lower ligaments, so as to form a cavity on each side of the larynx, opening between the two ligaments, which is called the *Ventricle of Morgagni.* The shape of each cavity is oblong. Its greatest length extends from behind forward, on each side of the opening into the windpipe formed by the two lower or principal ligaments; so that when the larynx is removed from the subject, upon looking into it from above, you perceive three apertures: one in the middle, formed by the two lower ligaments; and one on each side of it, between the lower and upper ligament, which is the orifice of the ventricle of Morgagni.

—If a probe be passed into this ventricle of the larynx, or ven-

tricle of Morgagni, it will be found to pass much above the superior thyro-arytenoid ligament, into a prolongation of the cavity of

Fig. 120.*



the ventricle, which extends as high as the upper margin of the thyroid cartilage, and which has been called by Mr. Hilton, the *Sacculus Laryngis.* It was pointed out by Morgagni, and has been compared by M. Cruvielhier, from its shape, to a Phrygian casque.—It is apt to escape observation in the healthy state. When death has taken place, from pulmonary emphysema, or laryngeal phthisis, I have, on several occasions, found the sac so large as to project considerably above the thyroid cartilage. The ventricle and its sac, appear to be intended for the supply of a lubricating secretion to the vocal chords, which are kept in such constant action, during respiration and phonation. The surface of the cavity, is studded with sixty or seventy small follicular glands, which are seated in the submucous tissue, and give to the mucous membrane, when dissected out, a rough appearance. The greater part of these follicles is placed in the sac, and the fluid which they form, is directed upon the rima glottidis, by two small folds of mucous membrane, at the entrance of the sacculus.—

The aperture between the two lower ligaments is called the *Rima Glottidis*, or *Chink of the Glottis;* the upper aperture, formed by the fold of the membrane and extending from the epiglottis to the arytenoid cartilages, may be termed *Glottis.*

—The folds of the membrane forming the upper margin of the glottis is loose and distensible, and is liable in laryngeal inflammation to become œdematous and bag out so as to impede respiration to a great extent, and even produce suffocation.—

If the windpipe is divided near the larynx, and the larynx inverted, so that the rima glottidis may be examined from below, the structure appears still more simple: it resembles a

* Fig. 120. Front view of the larynx; plan of its interior cavity, represented by the lines *a a*, *b b*. *ls*, Superior ligaments of the glottis. *li*, Inferior ligaments.

septum fixed abruptly in the windpipe, with an aperture in it of the figure of the rima glottidis.

The anterior surface of the two arytenoid cartilages is concave. This concavity is occupied in each by a glandular substance, which lies between the cartilage and the lining membrane; and extends itself horizontally, covered by the upper ligament of the glottis. The nature of these bodies is not perfectly understood; but they are supposed to secrete mucus.*

The membrane which lines the cavity of the glottis being continued from the mouth and throat, resembles the membranes which invest those parts. In some places, where it is in close contact with the cartilages, it appears united with the perichondrium, and acquires more firmness and density.

The *general* motions of the larynx are very intelligible to those who are acquainted with the muscles which are connected with the thyroid cartilage, and which move the os hyoides. They take place particularly in deglutition, and in some modifications of the voice; and also in vomiting.†

The motions of the *particular* cartilages on each other can also be well understood, by attending to the origin and insertion of the various small muscles connected with them. The most important of these muscles are the crico-arytenoidei postici and laterales, the thyreo-arytenoidei, the arytenoidei obliqui, and the arytenoideus transversus. The effects of their actions appear to be the dilating or contracting the rima glottidis, and relaxing or extending the ligaments which form it.

The arteries of the larynx are derived from two sources, namely, the superior thyroid, or laryngeal branch of the external carotid, and the thyroid branch of the subclavian.

The nerves of the larynx also come to it in two very different directions on each side. It receives two branches from the par vagum; one which leaves that nerve high up in the neck, and is called the *Superior Laryngeal* branch; and another

* They constitute the *glandulæ arytenoideæ*.—P.

† For an excellent exposition of the uses of the larynx, see Dunglison's Physiology, 4th edition.—

which proceeds from it after it has passed into the cavity of the thorax, and is called from its direction the *Recurrent.*

—According to M. Blandin, who has rather recently made some research upon this subject, the superior laryngeal nerve, is distributed chiefly to the mucous membrane and cryptæ of the larynx; it likewise sends some filaments to the arytenoid and crico-thyroid muscles, and others which anastomose with the branches of the recurrent. The recurrent supplies all the muscles of the larynx, with the exception of the crico-thyroid. There is still among anatomists some difference of opinion in regard to the distribution of these nerves.—

Muscles of the Larynx.

These are divided into *extrinsic* and *intrinsic.*

—The *extrinsic* muscles, which are attached by but one extremity to the larynx, have been already described. They consist of the sterno-hyoid, omo-hyoid, sterno-thyroid, and thyreo-hyoid; to which might indeed be added, all the muscles of the supra-hyoid region, and those of the pharynx, which are attached to the cricoid and thyroid cartilages. These, when they act upon the organ, move the entire larynx.

—The *intrinsic* muscles, are attached by both extremities to different parts of the larynx, and produce various movements in the different pieces of which it is composed. There are ten, viz., five pairs, and one single muscle which are called the *muscles of the chordæ vocales, and rima glottidis.* Those which exist in pairs are the crico-thyroid, the crico-arytenoidei postici, the crico-arytenoidei lateralis, the thyro-arytenoidei and the arytenoidei obliqui. The single muscle is the arytenoideus transversus. The oblique and the transverse arytenoid muscles consist, but of a few thin fibres with difficulty distingushed from each other and are spoken of by many anatomists, as a common muscle, called simply the arytenoid.

—There are three other minute muscles, which are called the *muscles of the epiglottis,* viz. the thyro-epiglottideus, the aryteno-epiglottideus superior, and another muscle lately observed by Mr. Hilton, called, aryteno-epiglottideus inferior.

1. *Crico-Thyroideus,*

Fig. 121.*

Arises from the side and forepart of the cricoid cartilage, running obliquely upwards.

Inserted by two portions: the first, into the lower part of the thyroid cartilage; the second, into its inferior cornu.

Use. To pull forwards and depress the thyroid, or to elevate and draw backwards the cricoid cartilage.

2. *Crico-Arytænoideus Posticus,*

Arises, fleshy, from the back part of the cricoid cartilage; and is

Inserted into the posterior part of the base of the arytenoid cartilage.

Use. To open the rima glottidis a little, and, by pulling back the arytenoid cartilage, to stretch the ligament so as to make it tense.

3. *Crico-Arytænoideus Lateralis,*

Arises, fleshy, from the cricoid cartilage, laterally, where it is covered by part of the thyroid, and is

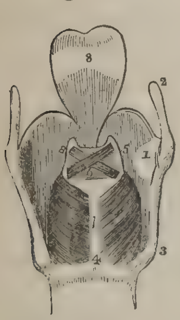
* The styloid muscles and the muscles of the tongue. 1. A portion of the temporal bone of the left side of the skull, including the styloid and mastoid processes, and the meatus auditorius externus. 2, 2. The right side of the lower jaw, divided at its symphysis; the left side having been removed. 3. The tongue. 4. The genio-hyoideus muscle. 5. The genio-hyo-glossus. 6. The hyo-glossus muscle; well seen at the base of the tongue. 7. Its portion connected with the os hyoides. 8. The anterior fibres of the lingualis issuing from between the hyo-glossus and genio-hyo-glossus. 9. The stylo-glossus muscle, with a small portion of the stylo-maxillary ligament. 10. The stylo-hyoid. 11. The stylo-pharyngeus muscle. 12. The os hyoides. 13. The thyro-hyoidean membrane. 14. The thyroid cartilage. 15. The thyro-hyoideus muscle arising from the oblique line on the thyroid cartilage. 16. The cricoid cartilage. 17. The crico-thyroidean membrane, through which the operation of laryngotomy is performed. 18. The trachea. 19. The commencement of the œsophagus.

Inserted into the side of the base of the arytenoid cartilage near the former.

Use. To open the rima glottidis, by pulling the ligaments from each other.

4. *Thyreo-Arytænoideus,*

Fig. 122.*



Arises from the under and back part of the middle of the thyroid cartilage; and, running backwards and a little upwards, along the side of the glottis, is

Inserted into the arytenoid cartilage, higher up and farther forwards than the crico-arytænoideus lateralis.

Use. To pull the arytenoid cartilage forwards nearer the middle of the thyroid, and consequently to shorten and relax the ligament of the larynx or glottis vera.

5. *Arytænoideus Obliquus,*

Arises from the base of one arytenoid cartilage; and crossing its fellow, is

Inserted near the tip of the other arytenoid cartilage.

Use. When both act they pull the arytenoid cartilages towards each other.

N. B. One of these is very often wanting.

The single muscle is, the

Arytænoideus Transversus,

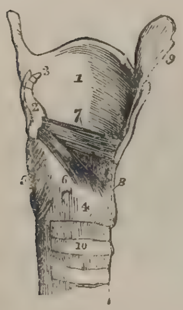
Arises from the side of one arytenoid cartilage, from near its articulation with the cricoid to near its tip. The fibres run straight across, and are

Inserted, in the same manner, into the other arytenoid cartilage.

* A posterior view of the larynx. 1. The thyroid cartilage. 2. One of its ascending cornua. 3. One of the descending cornua. 4. 7. The cricoid cartilage. 5, 5. The arytenoid cartilages. 6. The arytenoideus muscle, consisting of oblique and transverse fasciculi. 7. the crico-arytenoidei postici muscles. 8. The epiglottis.

Use. To shut the rima glottidis, by bringing these two cartilages, with the ligaments, nearer one another.

Fig. 123.*



Besides these, there are a few separate muscular fibres on each side; which, from their general direction, are named

1. *Thyro-Epiglottideus,*

Arises, by a few pale separated fibres, from the thyroid cartilage: and is

Inserted into the epiglottis laterally.

Use. To draw the epiglottis obliquely downwards, or, when both act, directly downwards; and at the same time, it expands that soft cartilage.

2. *Arytæno-Epiglottideus, superior.*

Arises, by a number of small fibres, from the lateral and upper part of the arytenoid cartilage; and, running along the outer side of the external rima, is

Inserted into the epiglottis along with the former.

Use. To pull that side of the epiglottis towards the external rima; or, when both act, to pull it close upon the glottis. It is counteracted by the elasticity of the epiglottis.

3. *Aryteno-Epiglottideus, inferior.*

This muscle may be exposed by raising the mucous membrane immediately above the ventricle of the larynx. It arises by a narrow and fibrous origin from the arytenoid cartilage, just above the attachment of the chorda vocalis—and passing forwards and a little upwards, expands over the upper half or two-thirds of the sacculus laryngis, and is inserted by a broad attachment into the side of the epiglottis. Its action according

* A side view of the larynx, one ala of the thyroid cartilage has been removed. 1. The remaining ala of the thyroid cartilage. 2. One of the arytenoid cartilages. 3. One of the cornicula laryngis. 4. The crycoid cartilage. 5. The crico-arytenoideus posticus muscle. 6. The crico-arytenoideus lateralis. 7. The thyro-arytenoideus. 8. The crico-thyroidean membrane. 9. One half of the epiglottis. 10. The upper part of the trachea.

to Mr. Hilton, is to approximate the epiglottis and arytenoid cartilage, to compress the subjacent glands which open into the pouch of the larynx, to diminish the capacity of that cavity and to change its form.

The extreme irritability of the glottis is unequivocally demonstrated by the cough, which is excited when a drop of water, or any other mild liquid, or a crumb of bread enters it. Notwithstanding this, a flexible tube, or catheter, has several times been passed into the windpipe through the rima glottidis, and been endured by the patient a considerable time.

The cough, which occurs when these parts are irritated, does not appear to arise exclusively from the irritation of the membrane within the glottis; for, if it were so, mucilaginous substances, when swallowed slowly, could not suspend it. Their effect in relieving cough is universally known; and as they are only applied to the surface exterior to the glottis, it is evident that the irritation of this surface must also produce coughing.

Several curious experiments have been made to determine the effect of dividing the different nerves which go to the larynx; by which it appears that the recurrent branches supply parts which are essentially necessary to the formation of the voice; whilst the laryngeal branches supply parts which merely influence its modulation, or tone. See Mr. Haigton's Essay on this subject: Memoirs of the Medical Society of London, vol. iii.

The Thyroid Gland, (see fig. 117, *p.* 454,*)*

May be described here, although a part of it is situated below the larynx.

This body consists of two lobes, which are united at their lower extremities by a portion which extends across the anterior part of the windpipe. Each lobe generally rises upwards and backwards from the second cartilaginous ring of the windpipe over the cricoid cartilage and a portion of the thyroid. It lies behind the sterno-hyoidei, and sterno-thyroidei muscles. It is of a reddish-brown colour, and appears to consist of a granular substance; but its ultimate structure is not understood. It is plentifully supplied with blood, and receives two arteries on each side: one from the laryngeal branch* of the external carotid: and the other from the thyroid branch of the subclavian.

Notwithstanding this large supply of blood, there is no

* The main branch from the external carotid, is now more commonly called *superior thyroid.*—P.

proof that it performs any secretion: for although several respectable anatomists have supposed that they discovered excretory ducts passing to the windpipe, larynx, or tongue, it is now generally agreed that such excretory ducts are not to be found. Several instances, have, however, occurred, in which air has been forced, by violent straining, from the windpipe into the substance of this gland.

[There are two membranous expansions in the neck which should be noticed in its dissection. The first, called Fascia Superficialis, lies immediately beneath the skin, may be considered as a continuation of the fascia superficialis abdominis, and is strongly connected to the base of the lower jaw, being also spread over the parotid gland. It is not very distinct in all subjects. The second is called the Fascia Profunda Cervicis; it extends from the larynx and thyroid gland to the upper part of the sternum and first ribs; the great vessels, &c. of the superior mediastinum are placed immediately below it.]

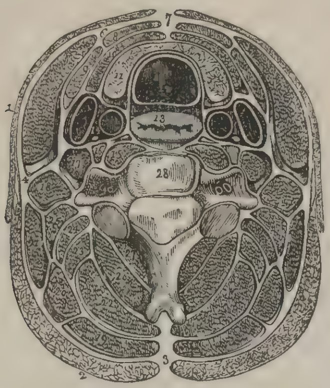
—The thyroid gland, gets a thin capsular investment, from two layers of the deep-seated cervical fascia, *(fascia profunda cervicis)* as seen in fig. 124.

—The same fascia likewise gives off layers, that form cellular investments or tunics to the trachea, œsophagus, and to the blood-vessels of the neck. Other processes pass off from it which supply sheaths to the sterno-cleido mastoid and other muscles of the neck. Between the sheaths of the different muscles of the neck, dense processes of cellular tissue are continued, so as to give them all the appearance of being formed as it were, from a common fascia. At the posterior part of the neck they are thus indirectly connected with the *ligamentum nuchæ*. Though this for practical purposes is not considered the best way for studying the fascia of the neck, it serves to give an idea of the continuity of the cellular investments, which is so common throughout the body. The accompanying cut and explanation is taken from Wilson.

—The two lobes of the thyroid gland, when extended and measured from side to side are together about three inches in

diameter. The lobes extend upwards on the sides of the larynx and downwards on the œsophagus, and lie upon the inner face of, and partly covering the primitive carotid artery and internal jugular vein. That part of the gland which unites the lobes

Fig. 124.*



together, and is stretched across the trachea, covering the two or three usually and *sometimes* the seven upper rings of the trachea, is called the isthmus of the gland. From the upper surface of the isthmus a process of the gland is usually seen

* A transverse section of the neck, showing the deep cervical fascia and its numerous prolongations, forming sheaths for the different muscles of the neck, the thyroid gland—trachea, œsophagus and blood-vessels. As the figure is symmetrical, the figures of reference are placed only on one side. 1. The platysma myoides. 2. The trapezius. 3. The ligamentum nuchæ, from which the fascia may be traced forwards beneath the trapezius, enclosing the other muscles of the neck. 4. The point at which the fascia divides, to form a sheath for the sterno-mastoid muscle (5). 6. The point of reunion of the two layers of the sterno-mastoid sheath. 7. The point of union of the deep cervical fascia of opposite sides of the neck. 8. Section of the sterno-hyoid. 9. Omo-hyoid. 10. Sterno-thyroid. 11. The lateral lobe of the thyroid gland. 12. The trachea. 13. The œsophagus. 14. The sheath containing the common carotid artery, internal jugular vein, and pneumogastric nerve. 15. The longus colli. The nerve in front of the sheath of this muscle is the sympathetic. 16. The rectus anticus major. 17. Scalenus anticus. 18. Scalenus posticus. 19. The splenius capitis. 20. Splenius colli. 21. Levator anguli scapulæ. 22. Complexus. 23. Trachelo-mastoid. 24. Transversalis colli. 25. Cervicalis ascendens. 26. The semi-spinalis colli. 27. The multifidus spinæ. 28. A cervical vertebra. The transverse processes are seen to be traversed by the vertebral artery and vein.

extending upwards, on the left side over the front surface of the larynx, to be attached by ligamentous fibres to the os hyoides. A small muscle called the levator glandulæ thyroideæ, has been described by Duverney, Soemmering and others, running down from the os hyoides in front of the larynx to the upper part of the isthmus of the gland. According to Professor Horner, its existence is very rare, with which opinion my own more limited observation coincides.

—The lobes of the gland are composed of smaller lobules, and the spongy structure of the latter, is filled with a yellowish and somewhat oily fluid. Of the uses of this gland nothing positively is known. Its importance in the system of the adult cannot be great, as its removal by extirpation, which has been many times practised, has not appeared to leave any functional lesion in the economy.—

Of the Pharynx.

The pharynx is a large muscular bag, which forms the great cavity behind the nose and mouth that terminates in the œsophagus.

It has been compared to a funnel, of which the œsophagus is the pipe; but it differs from a funnel in this respect, that it is incomplete in front, at the part occupied by the nose and mouth and larynx.

It is connected above, to the cuneiform process of the occipital bone, to the pterygoid processes of the sphenoidal, and to both the upper and lower maxillary bones. It is in contact with the cervical vertebræ behind; and, opposite to the cricoid cartilage, it terminates in the œsophagus.

If the pharynx and œsophagus be carefully dissected and detached from the vertebræ, preserving the connexion of the pharynx with the head, and the head then be separated from the body, by dividing the articulation of the atlas and the os occipitis, and cutting through the soft parts below the larynx, the resemblance to a funnel will be very obvious.

In this situation, if an incision be made from above downwards through the whole extent of the posterior part of the

pharynx, the communication of the nose, mouth, and windpipe, with this cavity, will be seen from behind at one view.

The openings into the nose, or the posterior nares, appear uppermost. Their figure is irregularly oval, or oblong; they are separated from each other by a thin partition, the vomer. Immediately behind, on the external side of each of these orifices, is the *Eustachian tube.* (See fig. 117, p. 454.)

The soft palate will appear extending from the lower boundary of the posterior nares, obliquely backwards and downwards, so as nearly to close the passage into the mouth. The uvula hangs from it: and, on each side of the uvula, the edge of the palate is regularly concave.

Below the palate, in the isthmus of the fauces, are the ridges or half arches, and the tonsils between them. The half arch which presents first, in this view, runs obliquely downward and backward, and not parallel to the other.

Close to the root of the tongue is the epiglottis erect; and, immediately adjoining it, is an aperture large enough to admit the end of a middle-sized finger. This aperture is widest at the extremity next to the epiglottis, and rather narrower at the other extremity: it is the *glottis* or opening of the windpipe. When the larynx is elevated, the epiglottis can be readily depressed so as to cover it completely.

The extremities of the arytenoid cartilages, and their appendices, may be recognised at the posterior edge of the glottis. At a short distance below this edge, the œsophagus begins.

The *Pharynx* is composed of the membrane continued from the nose and mouth internally, and of a stratum of muscular fibres externally. The internal membrane is very soft and flexible and perforated by many muciferous ducts. The surface which it forms is rather rough, owing to the mucous glands which it covers. It has a red colour, but not so deep as that of some other parts. It is connected to the muscular stratum by a loose cellular membrane.

The muscular coat consists of three different portions, which are considered as so many distinct muscles. They are called

the superior, middle, and inferior constrictor muscles of the pharynx.

The fibres of each of these muscles originate on each side, and run in an oblique direction to meet in the middle, thus forming the posterior external surface of the dissected pharynx.

The fibres of the *upper muscles* originate from the cuneiform processes of the occipital bone, from the pterygoid processes of the os sphenoides, and from the upper and lower jaws, near the last dentes molares, on each side. They unite in a middle line in the back of the pharynx.

The fibres of the *middle muscles* originate principally from the lateral parts of the os hyoides, and from the ligaments which connect that bone to the thyroid cartilage. The superior fibres run obliquely upwards, so as to cover a part of the first mentioned muscle, and terminate in the cuneiform process of the occipital bone; while the other fibres unite with those of the opposite side in the middle line.

The fibres of the *lower muscles* arise from the thyroid and the cricoid cartilages, and terminate also in the middle line: those which are superior, running obliquely upwards; the inferior, nearly in a transverse direction.

It is obvious, from the origin and insertion of these fibres, that the pharynx must have the power of contracting its dimensions in every respect; and, particularly, that its diameter may be lessened at any place, and that the whole may be drawn upwards.

PART VI.

OF THE THORAX.

Before the thorax is described, it will be in order to consider the

Mammæ;

Or those glandular bodies situated on the anterior part of it, which, in females, are destined to the secretion of milk.

These glands lie between the skin and the pectoral muscles, and are attached to the surfaces of those muscles by cellular membrane.

They are of a circular form; and consist of a whitish firm substance, divisible into small masses or lobes, which are composed of smaller portions or lobuli. Between these glandular portions, a great deal of adipose matter is so diffused, that it constitutes a considerable part of the bulk of the mammæ.

The gland, however, varies greatly in thickness in the same person at different periods of life.

The mammæ become much enlarged about the age of puberty. They are also very large during pregnancy and lactation; but after the period of child-bearing they diminish considerably. They are supplied with blood by the external and internal mammary arteries, the branches of which enter them irregularly in several different places.

The veins correspond with the arteries.

From the small glandular portions that compose the mamma, fine excretory tubes arise, which unite together and form the great lactiferous ducts of the gland. These ducts proceed in a

radiated manner from the circumference to the centre, and terminate on the surface of the nipple.*

They are commonly about fifteen in number, and vary considerably in size: the largest of them being more than one-sixth of an inch in diameter.†

Fig. 125.‡

They can be very readily injected by the orifices of the nipple, from a pipe filled with mercury, in subjects who have died during lactation or pregnancy; but they are very small in subjects of a different description.

It has been asserted by respectable anatomists, that these ducts communicate freely with each other; but they do not appear to do so; each duct seems to be connected with its proper branches only.§

Haller appears to have entertained the *remarkable senti-*

* Described in the 10th century, by Charles Etienne, Vesalius and Posthius, but their uses were unknown.—H.

† These ducts vary in number in different individuals, from fifteen to twenty.—P.

‡ Fig. 125, is a vertical section of the mammary gland of a young female who died during lactation. The ducts were injected with wax, and two dissected out their full length to their origin in the lobules of the gland. 2, 2, Base of the nipple. 3, 3, 3, Lactiferous ducts cut off at the base of the nipple. 4, 4, The top of the ducts exhibited their whole length. 5, 5, Sinuses formed by these ducts at the base of the nipple. 6, 6, 6, 6, Branches of these ducts running to the lobules. 7, 7, 7, 7, 7, The lobules separated from each other. 8, 8, The orifices of these ducts on the top of the nipple.

§ See Edinburgh Medical Commentaries, vol. i. p. 31.—A paper by Meckel.—H.

ment, that some of the ducts originate in the adipose matter about the gland, as well as in the glandular substance.*

The papilla, or nipple, in which these ducts terminate, is in the centre of the mamma: it consists of a firm elastic substance, and is nearly cylindrical in form. It is rendered tumid by irritation, and by certain emotions.

—This power of erectibility of the nipple is due to the presence of some *contractile tissue* in its composition analogous to the dortus structure of the scrotum. There is now believed to be no erectile tissue in its composition.—

The lactiferous ducts terminate upon its extremity. When it is elongated they can freely discharge their contents; but when it contracts, this discharge is impeded. The skin immediately around the nipple is of a bright red colour in virgins of mature age. In pregnant women it is sometimes almost black; and in women who have borne children it is often brownish. It abounds with sebaceous glands, which form small eminences on its surface.

—During gestation these follicles or glands are much increased in size, so as to become in consequence of this enlargement, one of the most certain signs of pregnancy. During suckling they are still farther enlarged, so as to appear like small pimples projecting from the skin, and serve by the increased secretion they throw out, to defend the nipple and areola, from the excoriating action of the saliva of the child.—

This gland exists in males, although it is very small. In boys, soon after birth, it has often been known to tumefy, and become very painful, in consequence of the secretion and accumulation of a whitish fluid, which can be discharged by pressure. It also sometimes swells and is painful, in males at the age of puberty.

There have been some instances in which it has secreted

* Elementa Physiologiæ, Tom. 7, Pars II. page 7. —In the adipose matter about the gland, the lactiferous tubes (*ducti galactophori*) appear to communicate with the absorbent vessels. In injecting the gland with mercury, I have frequently found the metal to pass off from the ducts along the absorbent vessels.—P.

milk in adult males; and a few instances also in which it has been affected with cancer, in the same sex.

The mamma is plentifully supplied with absorbent vessels, which pass from it to the lymphatic glands in the axilla.

Its nerves are principally derived from the great plexus formed by the nerves of the arm.

—The skin covering the mammary gland, is exceedingly thin, delicate and vascular, and that of the nipple and areola, more delicate and sensitive than any other portion.

—Each lactiferous duct by its branching and convolutions, forms a distinct lobule of the gland, and terminates in a series of vascular granules* about the size of millet seed, which are readily distinguished from each other in individuals who have died during lactation. The lobules of the gland vary in size, which, in subjects where the subcutaneous matter is not abundant, gives a feeling of unevenness or roughness to the gland.

—There are no valves in the lactiferous tubes.—

* Histoire de la Generation, par Grimaud de Caux et Martin Saint-Ange, 4to. Paris, 1837.—P.

CHAPTER XV.

OF THE GENERAL CAVITY OF THE THORAX.

Of the Form of the Cavity of the Thorax.

THE osseous structure of the thorax is described in page 155. The cavity is completed by the intercostal muscles, which close the vacuities between the ribs; and by the diaphragm, which fill up the whole space included within its lower margin.

If we except the apertures of the diaphragm, which are completely occupied by the aorta, the vena cava, and the œsophagus, &c., the only outlet of this cavity is above: it is formed by the upper ribs, the first dorsal vertebra, and the sternum. The figure of this aperture is between that of the circle and the oval; but it is made irregular by the vertebræ, and by the upper edge of the sternum.

When the superior extremities and the muscles appropriated to them are removed, the external figure of the thorax is conical; but the cavity formed by it is considerably influenced by the spine, which protrudes into it; while the ribs, as they proceed from the spine, curve backwards, and thus increase the prominency of the cavity.

The diaphragm has a great effect upon the figure of the cavity of the thorax. It protrudes into it from below, with a convexity of such form that it has been compared to an inverted bowl; so that although it arises from the lower margin of the thorax, the central parts of it are nearly as high as the fourth rib.

The position of the diaphragm is also oblique. The anterior portion of its margin, being connected to the seventh and eighth ribs, is much higher than the posterior portion, which is attached to the eleventh and twelfth.

In consequence of the *figure* and *position* of the diaphragm,

the form of the cavity of the thorax resembles that of the hoof of the ox when its posterior part is presented forwards.

Of the Arrangement of the Pleuræ.

The thorax contains the two lungs and the heart, as well as several very important parts of smaller size.

The lungs occupy the greatest part of the cavity; and to each of them is appointed a complete sac, called *Pleura*, which is so arranged that it covers the surface of the lungs, and is continued from it to the contiguous surface of the thorax, which it lines. After covering the lung, it is extended from it to the spine posteriorly: so that in tracing the pleura in a circular direction, if you begin at the sternum, it proceeds on the inside of the ribs, to the spine; at the spine it leaves the surface of the thorax, and proceeds directly forwards towards the sternum. In its course from the spine to the sternum, it soon meets with the great branch of the windpipe and blood-vessels, which go to the lung: it continues on these vessels and round the lung until it arrives at the anterior side of the vessels, when it again proceeds forwards until it arrives at the sternum. Each sac being arranged in the same way, there is a part of each extended from the spine to the sternum. These two laminæ form the great vertical septum of the thorax, called *Mediastinum.* They are situated at some distance from each other; and the heart, with its investing membrane or pericardium, is placed between them.

The pericardium is also a complete sac or bladder, which, after covering perfectly the surface of the heart, is extended from it so as to form a sac, which lies loose about it, and appears to contain it. This loose portion adheres to those parts of the laminæ of the mediastinum, with which it is contiguous; and thus three chambers are formed within the cavity of the thorax: one for each lung, and one for the heart.

The two laminæ of the pleura, which constitute the mediastinum, are at different distances from each other, in different places. At the upper part of the thorax, they approach each other from the internal edges of the first ribs; and as these

include a space which is nearly circular, the vacuity between these laminæ is necessarily of that form, at its commencement above.

Here, therefore, is a space between them above, *(Superior Mediastinum)* which is occupied by the transverse vein that carries the blood of the left subclavian and the left internal jugular to the superior cava; by the trachea; by the œsophagus; and by the subclavian and carotid arteries, as they rise from the curve of the aorta. This space is bounded below by the above mentioned curve of the aorta.

The heart and pericardium are so placed that there is a small-distance between them and the sternum: in this space the two laminæ of the mediastinum are very near to each other; and cellular substance intervenes between them. This portion of the mediastinum is called the *Anterior Mediastinum.**

Posteriorly, the heart and pericardium are also at a small distance from the spine; and here the lamina of the mediastinum are at a greater distance from each other, and form a long narrow cavity which extends down the thorax in front of the vertebræ: this is called the *Posterior Mediastinum.* It contains a considerable portion of the aorta as it descends from its curve, the œsophagus, the thoracic duct, and the vena azygos. The aorta is in contact with the left lamen, and can often be seen through it when the left lung is lifted up.

—The posterior and anterior mediastina are separated from each other by the pericardium which encloses the heart. But as the serous layers of the anterior, are reflected one on each side of the pericardium, to meet the posterior mediastinum, it appears to me to render the study of this part more easy, to

* This mediastinum, being placed in front of the longitudinal diameter of the pericardium is found at its lower part inclined to the left of the middle line. The cellular tissue between its layers, communicates indirectly with the cellular tissue on the outer side of the peritoneum, in the notch formed by the origin of the greater muscle of the diaphragm, under the xiphoid appendix of the sternum. By this channel, abscesses of the anterior mediastinum, may make their way externally upon the abdomen.—P.

consider that embracing the pericardium as a *middle* mediastinum.

The œsophagus is in contact with the right lamen; in its progress downwards, it inclines to the left side and is advanced before the aorta.

The vena azygos appears posterior to the œsophagus; it proceeds upwards until it is as high as the right branch of the windpipe: here it bends forward, round that branch, and opens into the superior cava, before that vein opens into the right auricle.

The thoracic duct proceeds upwards from below, lying in the space between the aorta and the vena azygos, until the beginning of the curve of the aorta, when it inclines to the left, proceeding towards the place of its termination.

—The anterior and posterior mediastinæ are formed as is shown above, by the layers of the pleura, between the sternum and pericardium, and between the pericardium and spine. But the pericardium does not extend the whole length of the thoracic cavity; it terminates about two inches short of the top of the sternum, and at this part, there being nothing interposed to divide the layers into an anterior and posterior portion, they pass directly from the vertebræ to the sternum, and constitute what is called the *Superior Mediastinum.* The two layers constituting this, continuous below with the anterior and superior mediastinæ, and each lining the upper margin of the first rib, so as to form a conical pouch projecting a slight distance above the middle of the clavicle, constitute a triangular cavity, the base of which is upwards, and corresponds to the root of the neck. This cavity contains the thymus gland, the arteria innominata, the primitive carotid and subclavian of the left side, the superior vena cava, the trachea, œsophagus, and par vagum nerve.

—The sympathetic nerve is not contained in this mediastinum; it passes a little to the outside of the posterior external angle of it.—

The formation of the mediastinum, and the arrangement of the pleura, as well as the connexion of these membranes with the parts contained in the thorax, may be

studied advantageously, after the subject has been prepared in the manner now to be described.

Take away, from each side, the five ribs which are situated between the first and last true ribs, by separating their cartilages from the sternum, and their heads from the spine; so that the great cavities of the thorax may be laid open.

The precise course of the mediastinum is thus rendered obvious; and the sternum may now be divided with a saw throughout its whole length in the same direction; so that the division of the bone may correspond with the space between the lamina of the mediastinum.

Separate the portion of the sternum cautiously, so as to avoid lacerating the lamina of mediastinum; and to keep them separate, while the trachea is dissected from the neck into the cavity of the thorax; the great transverse vein and the descending cava are dissected to the pericardium; and the left carotid artery, with the right subclavian and carotid, are dissected to the curve of the aorta, taking care not to destroy the lamina of the mediastinum.

After this preparation the upper space between the lamina of the mediastinum can be examined, and the relative situation of the trachea and the great vessels in it can be understood. The anterior mediastinum can also be studied: the root of each lung, or its connexion with the mediastinum, may be seen perfectly; and the precise situation of the lung, in its proper cavity, may be well conceived.

After this, while the portions of the sternum are separated, the pericardium may be opened, and the heart brought into view: the attachment of the pericardium, and to the mediastinum, and to the diaphragm, may be seen with advantage in this situation. The portions of the sternum may now be detached from the ribs, with which they remain connected; and further dissection may be performed to examine the posterior mediastinum and its contents, and the parts which constitute the roots of the lungs.

CHAPTER XVI.

OF THE HEART AND PERICARDIUM, AND THE GREAT VESSELS CONNECTED WITH THE HEART.

Of the Pericardium.

The heart is enclosed by a membranous sac, which, upon a superficial view, seems only connected with its great vessels.

—The whole of the organ lays unattached in the cavity of the sac, except, by the arteries and veins connected with its base. The sac is in fact composed of two layers, one external and fibrous, and one internal and serous ; the latter of these not only lines the inner face of the outer membrane, but is reflected like other serous membranes, over the roots of the vessels placed in the pericardium, and over the whole of the outer surface of the heart itself. This internal serous lining is very thin and delicate, and can only be raised in small shreds, either from the outer layer of the pericardium, or from the heart; except at the base of the latter organ, where, in females, it is usually, and in males, frequently, separated from the muscular tissue, by some sub-serous fatty matter.—

If it were dissected from the heart, without laceration or wounding, it would be an entire sac.

The pericardium, thus arranged, is placed between the two lamina of the mediastinum, and adheres firmly to them where they are contiguous to it; it also adheres firmly to the diaphragm below, and thus preserves the heart in its proper position.

The figure of the pericardium, when it is distended, is somewhat conical; the base being on the diaphragm. The cavity formed by it is larger than the heart after death, but it is probable, that the heart nearly fills it during life ; for when this

organ is distended by injection, it often occupies the whole cavity of the pericardium.

—The attachment of the pericardium to the diaphragm, is exactly over the cordiform tendon of the latter. The French anatomists have erroneously considered the fibrous layer of the pericardium, as a mere reflection of the tendon upwards. By separating them with a knife, we find, they are united by a short cellular tissue, which is densest and strongest at the periphery of their junction. The sides of the pericardium are covered in part by the pleura, which gives the sac the appearance of being formed by three tunics.

—Underneath the pleural lining, is found the phrenic nerve, and in fat subjects, a good deal of adipose matter.—

The pericardium is composed of two lamina, the internal of which covers the heart, as has been already described ; while the external merely extends over the loose portion of the other, and blends itself with the mediastinum, where that membrane invests the great vessels.

—Its principal attachment or termination above, is upon the arteries and veins entering the heart, (with the exception of the vena cava inferior,) over which it sends tubular prolongations, which gradually blend with their external coats. Between these prolongations on the inside of the sac, hollow pouches are necessarily left, which are called the cornua of the pericardium.

—The fibrous layer of the pericardium resembles in structure and appearance, the dura mater of the brain.

—The arteries of the pericardium are very small ; they are derived from the phrenic, bronchial, œsophageal, internal mammary arteries, and from the aorta itself. Its veins terminate in the vena azygos. Its nerves are few and small, and originate from the cardiac plexus.—

The internal surface of the pericardium is very smooth and polished ; and in the living subject is constantly moistened with a fluid which is probably effused from the exhalent vessels on its surface.

The quantity of this fluid does not commonly exceed two drachms ; but in cases of disease it sometimes amounts to

many ounces.* It is naturally transparent, but slightly tinged with red in children, and yellow in old persons. It is often slightly tinged with red in persons who have died by violence.

Of the Heart.

The great organ of the circulation consists of muscular fibres, which are so arranged that they give it a conical form, and compose four distinct cavities within it.

Two of these cavities, which are called *Auricles*, receive the contents of the veins; the other two communicate with the arteries, and are called *Ventricles.*

The auricles form the basis of the cone; the ventricles the body and apex.

The structure of the auricles is much less firm than that of the ventricles, and consists of a smaller proportion of muscular fibres. They appear like appendages of the heart, while the ventricles compose the body of the viscus.

The ventricles are very thick, and are composed of muscular fibres closely compacted.

The figure of the heart is not regularly conical; for a portion of it, extending from the apex to the base, is flattened; and in its natural position, this flat part of the surface is downwards.

It is placed obliquely in the body; so that its base presents backward and to the right, and its apex forward and to the left.

Notwithstanding this obliquity, the terms right and left are applied to the different sides of the heart, and to the different auricles and ventricles; although they might, with equal propriety, be called anterior and posterior.

The two great veins called *Venæ Cavæ*, which bring the blood from every part of the body, open into the right auricle from above and below; the right auricle opens into the right

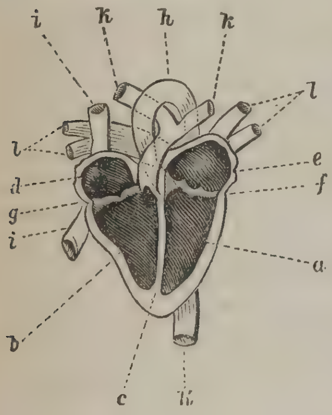
* The pericardium has been so distended, by effusion in dropsy, that it has formed a tumour, protruding on the neck from under the sternum. This tumour had a strong pulsating motion. It disappeared completely when the other hydropic symptoms were relieved.

ventricle; and from this ventricle arises the artery denominated *Pulmonary*, which passes to the lungs.

The *Pulmonary veins*, which bring back the blood from the lungs, open into the left auricle; this auricle opens into the left ventricle; and from this ventricle proceeds the *Aorta*, or great artery, which carries blood to every part of the body.

The heart is preserved in its position, 1st, by the venæ cavæ which are connected to all the parts with which they are contiguous in their course; 2d, by the vessels which pass between it and the lungs, which are retained in a particular position by the mediastinum; 3d, by the aorta, which is attached to the mediastinum in its course downwards, after making its great curve; and 4th, by the pericardium, which is attached to the great vessels and to the mediastinum. By these different modes the basis of the heart is fixed, while its body and apex are perfectly free from attachment, and only contiguous to the pericardium.

Fig. 126.*



The external surface of the heart, being formed by the serous layer of the pericardium, is very smooth: under this surface a large quantity of fat is often found.

The two auricles are contiguous to each other at the base, and are separated by a partition which is common to both.

The *Right Auricle* originates from the junction of the two venæ cavæ. These veins are united at some distance behind

* Fig 126.—Longitudinal section of the heart, showing its cavities. *b*, Right ventricle. *c*, Septum ventriculorum. *d*, Right auricle. *e*, Left auricle. *f*, Section of the mitral valves. *g*, Section of tricuspid valves. *h*, Arch of aorta. *h*, descending aorta. *i*, *i*, Vena cava superior and inferior. *k*, *k*, Right and left branches of the pulmonary artery. *l*, *l*, Pulmonary veins.

the right* ventricle, and are dilated anteriorly into a sac or pouch, which is called the *Sinus,* and extends to the right ventricle, to which it is united.†

The upper part of this pouch, or sinus, forms a point with indented edges, which is detached from the ventricle, but lies loose on the right side of the aorta. This point has some resemblance to the ear of a dog, from which circumstance the whole cavity has been called *auricle;* but by many persons the cavity is considered as consisting of two portions: the *Auricle,* strictly speaking; and the *Sinus Venosus,* above described: they however form but one cavity.

This portion of the heart, or *Right Auricle,* is of an irregular oblong figure. In its posterior surface, it is indented; for the direction of the two cavæ, at their junction, is not precisely the same; but they form an angle, which causes this indentation. The anterior portion of the auricle, or that which appears like a pouch between the ventricle and the veins, is different in its structure from the posterior part, which is strictly a portion of the veins. It consists simply of muscular fibres, which are arranged in fasciculi that cover the whole internal surface: this is also the case with the point, or that part which is strictly called *auricle.*

These fasciculi are denominated *Musculi Pectinati,* from their resemblance to the teeth of a comb.

That part of the internal surface, which is formed by the septum is smooth, and the whole is covered by a delicate membrane.

On the surface of the septum, below the middle, is an oval depression, which has a thick edge or margin: this is called the *Fossa Ovalis.*‡ In the fœtal heart, it was the *Foramen Ovale,* or aperture which forms the communication between the two auricles.

* In this description the heart is supposed to be in its natural position.

† At the place of junction of these veins there is a projection, indistinctly seen in man, but very manifest in some of the larger mammalia, called *tuberculum Loweri.*—P.

‡ The thick edge or margin is spoken of as the *annulus ovalis.*—P.

Near this fossa is a large semilunar plait, or valve, with its points and concave edge uppermost, and convex edge downwards. It was described by Eustachius, and therefore, is called the Valve of Eustachius.

—It commences at the lower surface of the opening of the inferior vena cava, and runs forwards to terminate below the fossa ovalis. It served in the fœtus to obstruct the passage of the venous blood from the right auricle into the right ventricle, and to direct it in a great measure through the foramen ovale.—

Anterior to this valve, and near the union of the auricle and ventricle, is the orifice of the proper vein of the heart, or the coronary vein. This orifice is covered by another semilunar valve, which is sometimes reticulated.*

The aperture, which forms the communication between the right auricle and right ventricle, is about an inch in diameter, and is called ostium venosum. From its whole margin arises a valvular ring, or duplicature of the membrane lining the surface: this circular valve is divided into three angular portions, which are called *Valvulæ Tricuspides.* From their margins proceed a great mumber of fine tendinous threads, which are connected to a number of distinct portions of muscular substance, which arise from the ventricle.

The *Right Ventricle,* when examined separately from the other parts of the heart, is rather triangular in its figure. It is composed entirely of muscular fibres closely compacted; and is much thicker than the auricle, although not so thick as the other ventricle. Its internal surface is composed of bundles or columns of fleshy fibres, which are of various thickness and length. Some of these columns *(columnæ carneæ)* arise from the ventricle, and are connected with the tendinous threads, *(chordæ tendineæ,)* which are attached to the margin of the tricuspid valves: the direction of them is from the apex of the

* The orifice is called the *foramen Thebesii*, and the valve *valvula Thebesii*, from the anatomist who first described them.

There are several other orifices in the neighbourhood of the foramen of Thebesius, by which some of the lesser coronary veins discharge into the right auricle.—P.

heart towards the base. Others of the columns arise from one part of the surface of the ventricle, and are inserted into another part. A third species are attached to the ventricle throughout their whole length, forming ridges or eminences on it. The columns of the two last described species are very numerous. They present an elegant reticulated surface when the ventricle is laid open, and appear also to occupy a considerable portion of the cavity of the heart, which some of them run across in every direction near the apex. They are all covered by a membrane continued from the auricle and the tricuspid valves; but this membrane appears more delicate and transparent in the ventricle than it is in the auricle.

—This is called the internal serous, or endo-cardial lining membrane of the heart. On the right side it is continuous with that of the veins and pulmonary artery, on the left with the aorta and pulmonary veins. It is extremely thin, smooth, and transparent, covers all the interior surface of the cavities of the heart, and by being thrown into folds, with some fibrous matter interposed between the layers to increase their strength, constitutes the valves.—

A portion of the internal surface of the ventricle, which is to the left, is much smoother and less fasciculated than the rest: it leads to the orifice of the pulmonary artery, which arises from it near the basis of the ventricle. This artery is very conspicuous, externally, at the basis of the heart.

It is very evident, upon the first inspection of the heart, that the valvulæ tricuspides will permit the blood to flow from the auricle to the ventricle; but must rise and close the orifice, and thereby prevent its passage back again, when the ventricle contracts.

The use of the tendinous threads, which connect the valves to the fleshy columns, is also very evident; the valve is supported by this connexion, and prevented from yielding to the pressure and opening a passage into the auricle. The blood, therefore, upon the contraction of the ventricle, is necessarily forced into the pulmonary artery; the passage to which is now perfectly free. In this artery the membrane lining the ventricle

seems continued; but immediately within the orifice of the artery, it is formed into three semicircular folds, each of which adheres to the surface of the artery by its circumference, while the edge constituting its diameter is loose. In the middle of this loose edge is a small firm tubercle, called *Corpusculum Arantii*,* which adds to the strength of the valve. Each of these valves, by its connexion with the artery, forms a sac or pocket, the orifice of which opens forward towards the course of the artery, and the bottom of it presents towards the ventricle. Blood will, therefore, pass from the ventricle in the artery, and along it without filling these sacs; and, on the contrary, in this course, will compress them and keep them empty. If it moves in the artery towards the heart, it will necessarily fill these sacs, and press the semicircular portions, from the sides of the artery, against each other; by this means a partition or septum, consisting of three portions, will be formed between the artery and the heart, which will always exist when the artery compresses, (or acts upon,) its contents. It is demonstrable, by injecting wax into the artery, in a retrogade direction, that these valves do not form a flat septum, but one which is convex towards the heart, and concave towards the artery; and that this convexity is composed of three distinct parts, each of which is convex. At the place where these valves are fixed, the artery bulges out when extended by a retrogade injection. The enlargements thus produced are called the *Sinuses* of *Valsalva*, after the anatomist who first described them. The valves are called *Semilunar*—and, although they are formed by a very thin membrane, they are very strong.

The *Left Auricle* is situated on the left side of the basis of the heart. It originates from the junction of the four pulmonary veins; two of which come from each side of the thorax, and appear to form a large part of it. It is nearly of a cubic form: but has also an angular portion, which constitutes the proper auricle, that proceeds from the upper and left part of

* After Arantius, a professor at Bologna, who first described it.

the cavity, and is situated on the left side of the pulmonary artery.

This auricle is lined by a small membrane, from which the valves between it and the ventricle originate; but it has no fleshy columns or musculi pectinati, except in the angular process properly called auricle.

These valves and the orifice communicating with the ventricle, resemble those which have been already described between the right auricle and ventricle: but with this difference, that the valvular ring is divided into two portions only, instead of three which are called *Valvulæ Mitrales.** The tendinous threads, which are connected to the muscular columns, are also attached to these valves, as in the case of the right auricle.

These valves admit the passage of blood from the auricle into the ventricle, but completely prevent its return when the ventricle contracts. One of them is so situated that it covers the mouth of the aorta while the blood is flowing into the ventricle, and leaves that orifice open when the ventricle contracts, and the passage to the auricle is closed.

The *Left Ventricle* is situated posteriorly, and to the left of the *Right Ventricle.* Its figure is different, for it is rather conical, and it is also longer.

The internal surface of this ventricle resembles that of the right ventricle: but the columnæ carneæ are stronger and larger.

On the right side of this ventricle is the mouth of the aorta. The surface of the ventricle near this opening is smooth and polished, to facilitate the passage of the blood.

The mouth of the aorta is furnished with three semilunar valves, after the manner of the pulmonary artery, but the former are stronger; the corpuscula Arantii are better developed in them. Indeed, Mr. Hunter does not admit of their existence in the pulmonary artery. The sinuses of Valsalva are about the same size in both arteries.

* From a resemblance in shape to the mitre or bishop's cap.—P.

The cavity of this ventricle is supposed to be smaller than that of the right: but the amount of the difference has not been accurately ascertained.

This ventricle must have much more force than the right, as its parietes are so much thicker. Their thickness often exceeds half an inch.

The difference in the strength of the two ventricles probably corresponds with the difference between the extent of the pulmonary artery and the aorta.

The thickness of the septum between the ventricles is thicker than the sides of the parietes of the right ventricle, and less thick than those of the left.

The muscular fibres of the heart are generally less florid than those of the voluntary muscles; they are also more closely compacted together. The direction of many of them is oblique or spiral; but this general arrangement is very intricate: it is such, however, that the cavities of the heart are lessened, and probably completely obliterated, by the contraction of these fibres.*

—The muscular fibres of the heart have been carefully studied by Wolf and Malpighi, and more recently still, by Mr. Searle† and M. Gerdy.‡ According to this latter anatomist, there is a fibrous zone or girdle formed around each auricle and arterial orifice of the heart, which zones are connected with each other and with the valves. From these zones originate all the muscular fibres of the heart. Some which run upwards and turn in every direction round the auricles, and form loops, the extremities of which are inserted on the opposite sides of the zone. Others which run downwards and embrace the ventricles, are also inserted on the opposite sides of the same zone, or that which surrounds the orifices of the aorta or pulmonary artery. The structure of the ventricular

* Mr. Home has given a precise description of the muscular fibres of the heart in his Croonian Lecture. London Philosophical Transactions for 1795, part I. page 215.

† Cyclopedia of Anatomy and Physiology. London.—Article—Fibres of the heart, of which he has given a minute and lengthened description.

‡ Journal Complementaire du Dict. des Scienc. Med. tom. ix. p. 97.—

fibres is most complicated. They are first superficially placed, and as they make their spiral turns, sink deep into the substance of the heart, somewhat like the contours of a leaf of paper rolled into the form of a cone. They consist of fibres proper to each ventricle, and fibres common to both. The former, after arising from the zone, turn spirally around the axis of the ventricle, so as to form many times the figure of 8, and coming upon the anterior face of the same side, terminate upon the zone surrounding the arterial orifice. The fibres common to the ventricles are of two kinds—superficial and deep-seated. The superficial are divided into anterior and posterior. The anterior arising from the anterior part of the arterial and auricular zones, run obliquely downwards and to the left, converging towards the apex of the heart; these are rolled around the axis of the left ventricle, and dip inwards to terminate in, or form the columnæ carneæ. The superficial part of this order of fibres, is common to both ventricles; the deep-seated part belongs to the left only. The posterior superficial fibres arise behind from the auricular zones only, and run downwards, so as to embrace the right border of the heart, come in front of the heart and opposite to the septum ventriculorum, dip under the anterior superficial fibres, wind round the axis of the right ventricle and terminate in its columnæ carneæ. These also in part only, are common to both ventricles.

—The deep-seated fibres form the internal part of the walls of the right ventricle. They arise from the fibrous zones of the right side. The anterior portion of these fibres runs obliquely downwards, and backwards to the septum; the posterior and internal, pass at once into the septum, roll themselves round the left ventricle and are lost amidst the other fibres. Thus it appears, that by removing the superficial layer of the common stratum, the heart may be divided into lateral halves, each consisting of two muscular sacs, an auricle and ventricle, adjoined to those of the opposite side in the middle line.—

The external surface of the heart is covered by that portion of the pericardium which adheres to it. Adipose matter is often

deposited between this membrane and the muscular surface; being distributed irregularly in various places.

This membrane is continued from the surface of the ventricles over that of the auricles. When it is dissected off from the place of their junction, these surfaces appear very distinct from each other.

The *proper blood-vessels* of the heart appear to be arranged in conformity to the general laws of the circulation, and are very conspicuous on the surface. There are two arteries which arise from the aorta immediately after it leaves the heart, so that their orifices are covered by two of the semilunar valves. One of these passes from the aorta between the pulmonary artery and the right auricle, and continues in a circular course in the groove between the right auricle and the right ventricle, and sends off its principal branches to the right side of the heart.

The other artery of the heart passes between the pulmonary artery and the left auricle. It divides into two branches; one, which is anterior, passes to a groove on the surface, corresponding to the septum between the two ventricles, and continues on it to the apex of the heart, sending off branches in its course; another, which is posterior and circumflex, passes between the left auricle and ventricle.

The great vein of the heart opens into the under side of the right auricle, as has been already mentioned: the main trunk of this vein passes for some distance between the left auricle and ventricle.*

* It was asserted by Vicussens, at an early period in the last century, and soon afterwards by Thebesius, a German Professor, that there were a number of small orifices in the texture of the heart, which opened into the different cavities on both sides of it.

This assertion of a fact so difficult to reconcile with the general principles of the circulation, was received with great hesitation: and although it was confirmed by some very respectable anatomists of the last century, it was denied by others. Some of the anatomists of the present day have denied the existence of these orifices, and some others have neglected them entirely.

The subject was brought forward in the London Philosophical Transactions of 1798, Part I. by a very respectable anatomist, Mr. Abernethy, who states that he has often passed a coarse waxen injection from the proper arteries and veins of the

From the course of these different vessels round the basis of the ventricles of the heart, they are generally called *Coronary Vessels:* the arteries are denominated, from their position, *Right and Left Coronary.*

The nerves of the heart come from the cardiac plexus, which is composed of threads derived from the intercostal or great sympathetic nerves, and the nerves of the eighth pair.

Of the Aorta, the Pulmonary Artery and Veins, and the Venæ Cavæ; at their commencement.

The two great arteries, which arise from the heart, commence abruptly, and appear to be extremely different in their composition and structure from the heart.

They are composed of a substance, which has a whitish colour, and very dense texture, and is very *elastic* as well as firm and strong.

When the pericardium is removed, these arteries appear to proceed together from the upper part of the basis of the heart: the pulmonary artery being placed to the *left* of the aorta with the left auricle on the left side of it, and the right auricle on the right side of the aorta. The pulmonary artery arises from the most anterior and left part of the basis of the right ventricle, and proceeds obliquely backwards and upwards; inclining gradually to the left side for about eighteen or twenty lines; when it divides into two branches which pass to the two lungs.

The aorta arises from the left ventricle, under the origin of

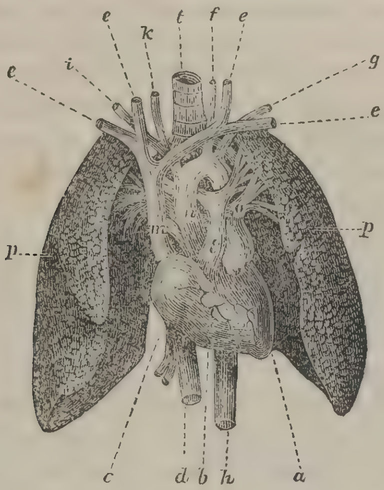
heart into all the cavities of that organ, and particularly into the *Left Ventricle. But it was only in subjects with diseased lungs that this was practicable.*

The existence of this communication between the coronary vessels and the great cavities of the heart seems therefore to be proved. The easy demonstration of such subjects is ingeniously referred by Mr. Abernethy, to the obstruction of the circulation in the lungs; and he regards the communication as a provision enabling the coronary vessels to unload themselves, when the coronary vein cannot discharge freely into the right auricle.*

* This assertion of Mr. Abernethy's, has not been confirmed by subsequent investigations, except in cases where the tissue of the heart was softened, and its vessels had been ruptured by the force of the injection.—P.

the pulmonary artery, and immediately proceeds to the right, covered by that vessel, until it mounts up between it and the right auricle: it then forms a great curve, or arch, which turns backward and to the left, to a considerable distance beyond the pulmonary artery. In this course, it crosses the right branch of the pulmonary artery; and, turning down in the angle between it and the left branch, takes a position on the left side of the spine.

Fig. 127.*



The course of this artery, from its commencement at the ventricle, to the end of the great curve or arch, is extremely varied.

The uppermost part of the curve is in the bottom of the

* Fig. 127.—*a*, Left ventricle. *b*, Right ventricle. *c*, Right auricle. The left auricle is seen above the left ventricle of the same side. *d*, Vena cava inferior. *e*, Subclavian and jugular veins; those of the left side unite to form the vena transversa; those of the right, to form the vena innominata; the junction of these larger trunks, constitutes the vena cava superior or descendens. *f*, Left carotid. *g*, Left subclavian artery, arising from the arch of the aorta. *h*, Descending aorta. *i*, *k*, Right subclavian, and right carotid, given off from the arteria innominata, which is seen arising from the arch of the aorta. *l*, Pulmonary artery, dividing into two branches, one for each lung—the left passing in front of the descending aorta, the right, behind the aorta, where it begins to form the curve. *m*, Vena cava superior. *n*, Aorta. *o*, Left pulmonary veins, entering auricle of same side. The right pulmonary veins, are seen on the opposite side. *p*, *p*, Lungs. *t*, Trachea.—P.

chamber formed by the separation of the lamina of the mediastinum when they join the first rib on each side.

From this part of the curve three large branches go off, namely, one, which soon divides into the carotid and the subclavian arteries of the right side; a second, somewhat smaller, which is the left carotid; and a third, which is the left subclavian artery.

When the heart and its great vessels are viewed from behind, (after they have all been filled with injection; and the pericardium, mediastinum, and windpipe have been removed,) the aorta appears first, descending behind the other vessels; the pulmonary artery then appears, dividing so as to form an obtuse angle with its two great branches, each of which divides again before it enters the lung to which it is destined.

Under the main trunk of the pulmonary artery, is the left auricle: its posterior surface is nearly of a square form, and each of the pulmonary veins proceeds from one of its angles. These veins ramify in the substance of the lungs, at a very short distance from the auricle: the two uppermost of them are situated rather anterior to the branches of the pulmonary artery.

In this posterior view, the pulmonary vessels of the right side cover a great part of the right auricle, as it is anterior to them. The lower portion of the auricle, with the termination of the inferior cava, is to be seen below them. Above them the superior cava appears; and in that part of it which is immediately above the right branch of the pulmonary artery, is the orifice of the vena azygos.

In its natural situation in the thorax, the superior cava is connected by cellular membrane to the right lamen of the mediastinum, and is supported by it. At a small distance below the upper edge of the sternum, it receives the trunk formed by the left subclavian and internal jugular vein, which passes obliquely across the sternum below its inner edge, in the upper space between the lamina of the mediastinum.

CHAPTER XVII.

OF THE TRACHEA AND THE LUNGS.

ALTHOUGH the principal part of the windpipe is situated in the neck above the cavity of the thorax, it is so intimately connected with the lungs, that it is necessary to describe them together.

Of the Trachea.

Trachea is the technical name for the windpipe, or the tube which passes from the larynx to the lungs.

This tube begins at the lower edge of the cricoid cartilage, and passes down the neck in front of the œsophagus as low as the third dorsal vertebræ, when it divides into two branches called *Bronchia*, one of which goes to the right and the other to the left lung, in which they ramify very minutely.

—The *right bronchium* is larger than the *left*, in proportion to the greater size of the right lung. It is also shorter and placed more anterior and more horizontal than the left, in consequence of the right lung being shorter in its vertical diameter, and longer in its antero-posterior than the lung of the left side. It enters near the centre of the root of the lung, opposite to the fourth dorsal vertebra.

—The *left bronchium* terminates or enters the root of the left lung, opposite the fifth dorsal vertebræ. The right bronchium is embraced at its upper part by the vena azygos, the left by the arch of the aorta.—

There is in the structure of each, a number of flat cartilaginous rings placed at small distances from each other, the edges of which are connected by membrane, so that they compose a tube.

These cartilaginous rings are not complete, for they do not form more than three-fourths or four-fifths of a circle; but their ends are connected by a membrane which forms the posterior part of the tube.

They are not alike in their size or form; some of them are rendered broader than others, by the union of two or three rings with each other, as the uppermost. The lowermost also is broad, and has a form which is accommodated to the bifurcation of the tube. Their number varies in different persons, from fifteen to twenty.

These rings may be considered as forming a part of the first proper coat of the trachea, which is composed of them, and of an elastic membrane that occupies all the interstice between them; so that the cartilages may be regarded as fixed in this membrane.

A similar arrangement of rings exists in the great branches of the bronchia; but after they ramify in the lungs, the cartilages are no longer in the form of rings: they are irregular in their figures, and are so arranged in the membrane, that they keep the tube completely open. These portions of cartilage do not continue throughout the whole extent of the ramifications; for they become smaller, and finally disappear, while the membranous tube continues without them, ramifying minutely, and probably forming the air-cells of the lungs.

—At the orifices of the bronchial ramifications, the existence of a semilunar cartilage has been pointed out by Prof. Horner, forming rather more than half of their circumference, and having its concave edge turned upwards. These cartilages appear to be intended to keep the orifices open.*—

The membranous is very elastic: the lungs are very elastic also; and it is probable that their elasticity is derived from this membrane.

On the inside of this coat of the trachea is an arrangement of musclar fibres, which may be called a *muscular coat*. It is best seen by peeling off or removing the internal coat, to be next described.

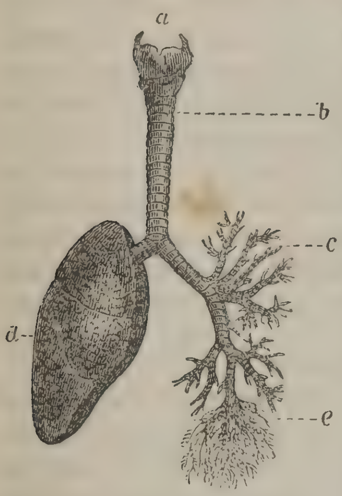
On the membranous part of the trachea, where the cartilaginous rings are deficient, these muscular fibres run evidently in a transverse direction: in the spaces between the cartilages

* Special Anatomy, by W. E. Horner, M. D. Prof. Anat. Univers. Pennsylvania.

their direction is longitudinal. There is some reason to doubt whether these longitudinal fibres are confined altogether to the spaces between the cartilaginous rings, and attached only to their edges, because there is a fleshy substance on the internal surface of the rings, which appears to be continued from the spaces between them.

The internal coat of the trachea is a thin and delicate membrane, perforated with an immense number of small foramina, which are the orifices of mucous ducts.

Fig. 128.*



On the surface of this membrane there is an appearance of longitudinal fibres which are not distributed uniformly over it, but run in fasciculi in some places, and appear to be deficient in others. These fasciculi are particularly conspicuous in the ramifications of the bronchia in the lungs.

—Many of the German anatomists have described these as longitudinal muscular fibres, the object of which is to shorten to some extent the air-passages during their contraction, and to assist in loosening the mucus and other matters which accumulate in their cavities. I have examined these carefully in the ox and elephant, where they are strongly marked; they appeared to me to consist only of longitudinal folds of mucous membrane, with a basis of the fibrous *contractile tissue.* The same arrangement of circular fibres, and these peculiar longitudinal fibres, can be traced with the microscope down the bronchia as far as

* Fig. 128, represents the larynx, trachea, and bronchia; on the right side is seen the lung; on the left, the lung has been destroyed to show the ramification of the bronchia. *a*, Larynx. *b*, Trachea, dividing into right and left bronchium; the left is the smaller, longer, and inclined most downwards. *c*, Larger divisions of the left bronchium; *e*, the more minute. *d*, Right lung.—P.

these can be distinctly opened. The contractibility of the pulmonary tissue under the influence of galvanism observed by Dr. C. J. B. Williams, seems to establish the muscularity of the circular fibres.—

On the posterior membranous portion of the trachea, where the cartilages are deficient, a considerable number of small glandular bodies are placed, which are supposed to communicate with the mucous ducts that open on the internal surface. If these bodies are removed from the external surface of this portion, and the muscular fibres are also removed from the internal, a very thin membrane only remains, which is very different from that which is left between the rings, when the fleshy substance is removed from that situation.

The reason of the deficiency in the rings, at this posterior part, is not very obvious.* It continues in the bronchia until the form of their cartilages is changed in the lungs: if it were only to accommodate the œsophagus, during the passage of food, there would be no occasion for its extension to the bronchia.

At the bifurcation of the trachea, and on the bronchia, are a number of black coloured bodies, which resemble the lymphatic glands in form and texture. They continue on the ramifications of the bronchia some distance into the substance of the lungs. Their number is often very considerable; and they vary in size from three or four lines in diameter to eighteen or twenty. As lymphatic vessels have been traced to and from them during their course to the thoracic duct, they are considered as lymphatic glands.

Of the Lungs.

There are two of these organs: each of which occupies one of the great cavities of the thorax.

When placed together, in their natural position, they resemble the hoof of the ox, with its back part forward; but they are

* Dr. Physick has advanced the opinion that it enables a person to expel the mucus of the lungs by contracting the size of the trachea, and consequently increasing the velocity or impetus of the air.—H.

at such a distance from each other, and of such a figure, that they allow the mediastinum and heart to intervene; and they cover every part of the heart anteriorly, except a small portion at the apex.

Each lung fills completely the cavity in which it is placed, and every part of its external surface is in contact with some part of the internal surface of the cavity; but when in a natural and healthy state, it is not connected with any part except the lamina of the mediastinum.

—The lower extremity or base of each lung, rests upon the pleural lining of the diaphragm, and fills up the angle between the diaphragm and the ribs; the superior projects upwards and backwards, along the first rib and above the level of the clavicle, so asto be separated from the scalenus anticus muscle only by the pleura. In laborious respiration, the elevation of the apex of the lung is increased, and the motion it produces becomes visible at the root of the neck. The external face of the lungs is convex, to suit the contour of the thoracic parietes. The internal, and especially that of the left, is concave to accommodate the heart and pericardium. The anterior edge is thin and sinuous, and presents on the left side a deep notch fitted to the shape of the heart, and a sort of lobular projection which in part covers that organ during deep inspiration.—

One great branch of the trachea and of the pulmonary artery passes from the mediastinum to each lung, and enters it at a place which is rather nearer to the upper rib than to the diaphragm, and much nearer to the spine than the sternum: at this place also the pulmonary veins return from the lungs to the heart.

These vessels are enclosed in a membrane, which is continued over them from the mediastinum, and extended from then to the lung. Thus covered they constitute what has been called the *Root of the Lung*.

When their covering, derived from the mediastinum, is removed, the situation of these vessels appears to be such that the bronchia are posterior, the branches of the pulmonary

artery are rather above and before, and the veins below and before them.

Each of these vessels ramifies before it enters into the substance of the lungs: the bronchia and the branches of the pulmonary artery send each a large branch downward to the inferior part of the lungs, from which the lower pulmonary veins pass in a direction nearly horizontal. In general, each of the smaller ramifications of the bronchia in the lungs is attended by an artery and a vein.

Each lung is divided, by very deep fissures, into portions which are called *Lobes.* The right lung is composed of three of these lobes, and the left lung of two. (See fig. 127, page 515.)

—Each of these lobes are subdivided into many smaller parts called lobules, which are marked out on the surface of the lungs, by various angular lines. Each bronchium divides into two principal branches for the lobes of the left lung, and into three for the right; after which, a still further subdivision takes place, so that a terminal bronchial branch is sent to each lobule.—

The lungs are covered, as has been already stated, with the reflected portion of the pleura continued from the mediastinum, which is very delicate and almost transparent. They have, therefore, a very smooth surface, which is kept moist by exudation from the arteries of the membrane.

The *Colour of the Lungs* is different in different subjects. In children they are of a light red colour; in adults they are often of a light gray, owing to the deposition of a black pigment in the substance immediately under the membranes which form their external surface. Their colour is often formed by a mixture of red and black. In this case they are more loaded with blood, and the vessels of the internal membranes being distended with it, the red colour is derived from them.

The black pigment sometimes appears in round spots of three or four lines in diameter: under the external membrane it is often in much smaller portions, and sometimes is arranged in

lines in the interstices of the lobuli, to be hereafter mentioned. It is also diffused in small quantities throughout the substance of the lungs.

The sources of this substance, and the use of it, are unknown.

The lungs are of a soft spongy texture ; and, in animals that have breathed, they have always a considerable quantity of air in them.

They consist of cells, which communicate with the branches of the trachea that ramify through them in every part. These cells are extremely small, and the membranes which compose them are so thin and delicate, that if they are all filled by an injection of wax, thrown into the trachea, the whole cellular part of the lung will appear like a mass of wax. If a corroded preparation be made of a lung injected in this manner with force, the wax will appear like a concretion.

These effects of injections prove that the membranes of which the cells are formed are very thin ; and, of course, that their volume is very small when compared with the capacity of the cells.

In those corroded preparations, in which the ramifications of the bronchia are detached from the wax of the cells, these ramifications become extremely small indeed.—The cells above alluded to are in fact but the ultimate termination of the last branches of the bronchia in small dilated sacs, called the bronchial or pulmonary cells.—

If the lungs of the human subject, or of animals of similar construction, be examined when they are inflated, their cellular structure will be very obvious, although their cells are so small that they cannot commonly be distinguished by the naked eye. Each of the extreme ramifications of the bronchia appears to be surrounded by a portion of this cellular substance, which is gradually distended when air is blown into the ramification.

This cellular substance is formed into small portions of various angular figures, which are denominated *Lobuli:* these can be separated to a considerable extent from each other.

They are covered by the proper coat of the lungs, which is extremely delicate, and closely connected to the general covering derived from the pleuræ. Between the lobuli, where they are in contact with each other, there is a portion of common cellular substance, which is easily distinguished through the membrane covering the lungs. This is very distinct from the cellular structure which communicates with the ramifications of the bronchia, and contains air; for it has no communication with the air, unless the proper coat of the lungs be ruptured. If a pipe be introduced by a puncture of the external coat of the lungs, and this interstitial cellular membrane be inflated, it will compress the lobuli. This cellular membrane is always free from adipose matter: it may be easily examined in the lungs of the bullock.

Upon the membranes which compose the air-cells, the pulmonary artery and vein ramify most minutely; and it seems to have been proved by the united labours of chemists and physiologists, that the great object of respiration is to effect a chemical process between the atmospheric air, when taken into the air-cells, and the blood which circulates in these vessels.

In addition to the blood-vessels which thus pass through the substance of the lungs, there are several smaller arteries denominated *Bronchial*, which arise either from the upper intercostal, or from the aorta itself; they pass upon the bronchia, and are distributed to the substance of the lungs. The veins which correspond with these arteries terminate ultimately in the vena azygos.

The nerves of the lungs are small in proportion to the bulk of these organs. They are derived principally from the par vagum and the intercostal nerves.

—They form one plexus on the front, and another on the posterior surface of the bronchia, along which they are conducted to the minutest subdivision of the latter in the substance of the lungs.—

The elasticity of the air-cells of the lungs and of the ramifications of the bronchia which lead to them, is apparent in their

rapid contraction after distention, and by the force with which they expel the air which is used to inflate them when taken out of the thorax.

—The specific gravity of the lungs is not naturally greater than that of many other tissues. In a still-born child, sections of it sink in water like a piece of muscle. But when its cells have been once distended by air in respiration it becomes impossible to extrude it completely (unless it is subjected to strong compression) and the lung floats upon the water and appears to have the least specific gravity of all the animal tissues. The lungs are endowed with a considerable degree of elasticity, that appears to be derived from the elastic tissue of the bronchia which is spread universally through the lungs. When distended they have a constant tendency either in or out of the body to return upon themselves and expel the air.

—It will now be seen that the *proper tissue* of the lungs, the *parenchyma*, the *areolar tissue*, is very complicated. It consists of the cells of the bronchia for the reception of air, which are formed internally of mucous membrane and externally most probably of a thin expansion of the yellow elastic ligamentous layer of the bronchia; of a branch of the pulmonary arteries and veins, which run over the outer surface of the cells, the former bringing the black blood, and the latter conveying it away after it has been changed by the action of the air through the walls of the cells; of the bronchial arteries and veins for the purpose of nutrition; of absorbent vessels to remove the molecules as they become effete; of filaments of the sympathetic and par vagum nerves, which preside over the function of hæmætosis, and put the lungs in connexion with the brain; and lastly of cellular tissue which unites the whole together. The mucous membrane lining the trachea, bronchia, and air cells, when examined with the microscope, have been found lined with a columnar epithelium, mounted with vibratile cilia, the same as has been described as covering the Schneiderian membrane. The use of the cilia in these organs, it is believed, is that of aiding in urging the secretions upwards towards the larynx.

—Between the bronchial and pulmonary arteries and veins, there is an intimate anastomosis so that either system of vessels may be filled by the use of fine injecting fluid through the other. The cells of each lobule, according to Professor Horner, Cloquet, and some other anatomists of distinction, communicate laterally with each other. Reisseissen, Gerber, and other microscopists, figure each one as a perfect cul de sac; the developement of the lungs in the fœtus resembling in its early stages very closely that of the compound glands. The diameter of these cells has been measured by Weber of Leipzig,* by the aid of a micrometer attached with extreme care and ingenuity to a microscope. According to him they are upon an average about $\frac{1}{200}$ part of an inch in diameter, which makes them five or six times larger than the cells of the parotid gland, and fifteen or twenty times larger than the finest capillary blood-vessels measured on a portion of skin which had been very perfectly injected by Dr. Pockels of Brunswick.—

The Thorax of the Fœtus.

In the cavity between the lamina of the mediastinum, where they approach each other from the first ribs, is situated, a substance which is denominated the

Thymus Gland.

This substance gradually diminishes after birth, so that in the adult it is often not to be found: and when it exists it is changed in its texture, being much firmer, as well as greatly diminished.

In the fœtus it is of a pale red colour; and during infancy it has a yellowish tinge. It generally extends from the thyroid gland, or a little below it, to the pericardium. From its superior portion two lateral processes are extended upwards: below, it is formed into two lobes, which lie on the pericardium.

If an incision be made into its substance, a fluid can be

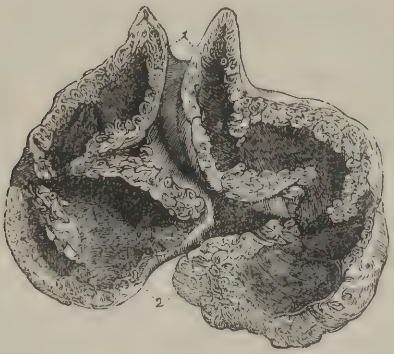
* Meckel's Archiv. fur Anat. and Physiol., 1830.—

pressed out, which has a whitish colour, and coagulates upon the addition of alcohol.

Although it is called a *gland*, no excretory duct has ever been found connected with it.

—The thymus gland in the fœtus at birth, extends from the fourth rib, as high up as the thyroid gland. It rests upon the pericardium below, and is separated from the arch of the aorta and the great vessels, by a fasciæ, called by Sir A. Cooper, the thoracic, which is composed of a dense layer of fibro-cellular membrane, stretched between the concave margins of the first rib of each side horizontally across the upper opening of the

Fig. 129.*



thorax. It is connected below with the fibrous sac of the pericardium, with the arch of the aorta which it in a measure sustains, and the great vessels that come off from it. Above, it is connected with the sheath of the carotid, and the deep cervical and tracheal fasciæ. This fascia has an opening in

* A section of the thymus gland at the eighth month, showing its anatomy. This figure is taken from one of Sir Astley Cooper's beautiful engravings. 1. The cervical portions of the gland; the independence of the two lateral glands is well marked. 2. Secretory cells seen upon the cut surface of the section; these are observed in all parts of the section. 3, 3. The pores or openings of the secretory cells and pouches; they are seen covering the whole internal surface of the great central cavity or reservoir. The continuity of the reservoir in the lower or thoracic portion of the gland, with the cervical portion, is seen in the figure.

front, through which passes up the cervical portion of the thymus gland.

—The gland consists of two halves, connected in the middle by cellular tissue only, which may properly be called a right and left lobe. According to Sir A. Cooper, who has published a beautiful monograph on the structure of this organ, the gland grows gradually with the increasing growth of the fœtus, till the seventh month. During the ninth it is suddenly and greatly increased in size, and at birth weighs two hundred and forty grains. It continues to enlarge till the end of the first year after birth, when it begins to diminish in size, and by the period of puberty has almost entirely disappeared. Each right and left lobe, is composed of lobules disposed in a spiral form round a central cavity, which is called a reservoir.

—The lobules are held together by dense cellular tissue, and, the whole gland is surrounded by a coarse cellular capsule. The *lobules* which make this a conglomerate gland are very numerous, and vary in size from that of the head of a pin to a common pea. In each lobule there is a small cavity or *secretory cell.* Several of these cells open into a small *pouch*, and this again into the central cavity or *reservoir*, which is lined by a vascular mucous membrane.

—Each lobe of the gland may be carefully unravelled by removing the coarse cellular capsule and vessels, and dissecting away the firm cellular tissue that holds the lobules together; the reservoir then, which in its natural state is folded in a serpentine manner upon itself, may be drawn out into a lengthened tubular cord, around which the *lobules* are clustered in a spiral manner, and resemble knots upon a cord, or a string of beads. The reservoir, pouches, and cells, contain a white fluid like chyle or cream, with a small admixture of red globules. The use of this gland is not known. Sir A. Cooper, is disposed to believe, in common with several of the older writers, that the gland is designed to prepare a fluid from the blood of the mother, well fitted for the growth and nourishment of the fœtus before its birth, and consequently, before chyle is formed by it from food; this process continuing for a short time after

birth—the quantity of fluid secreted from the thymus, gradually declining, as that of chylification becomes perfectly established.—

Fig. 130.*

The arteries of this body are derived from the thyroid branches of the subclavians, from the internal mammaries, and the vessels of the pericardium and mediastinum.—The veins terminate mainly in the left vena innominata.

—The nerves are very minute, and are chiefly derived through the plexus about the internal mammary artery from the superior thoracic ganglion of the sympathetic. The lymphatics terminate at the common junction of the other vessels of the kind, at the union of the internal jugular and subclavian veins. Sir A. Cooper has injected them but once in the human fœtus. In the calf he found two large lymphatic ducts, see fig. 130, which commence at the upper extremities of the lobes, and pass downwards to terminate at the junction of the jugular and subclavian of each side. These vessels he considers the *absorbent* ducts of the glands—the *thymuc ducts* which carry the fluid from the reservoir of the thymus into the veins.—

The Heart,

And the great arteries which proceed from it, have some very interesting peculiarities in the fœtus.

* The course and termination of the "absorbent ducts" of the thymus of the calf; from one of Sir Astley Cooper's preparations. 1. The two internal jugular veins. 2. The superior vena cava. 3. The thoracic duct, dividing into two branches, which re-unite previously to their termination in the root of the left jugular vein. 4. The two thymic ducts; that on the left side opens into the thoracic duct, and that on the right into the root of the right jugular vein.

In the septum between the two auricles, is a foramen of sufficient size to permit the passage of a large quill, which inclines to the oval form, with its longest diameter vertical when the body is erect. On the *left* side of the septum, a valve, formed by the lining membranes, is connected to this foramen; and allows a free passage to a fluid moving from the right auricle to the left; but prevents the passage of a fluid from the left to the right. This structure is evidently calculated to allow some of the blood which flows into the right auricle from the two venæ cavæ to pass into the left auricle of the heart, instead of going into the right ventricle. As the contents of the left auricle pass into the left ventricle, and from thence into the aorta, it is obvious that the blood which passes from the right auricle into the left through this foramen, must be transmitted from the system of the vena cava to the system of the aorta, without going through the lungs, as it must necessarily do in subjects who do not enjoy the fœtal structure.

—The valve, with which in the fœtus the foramen ovale is provided, on the side of the left auricle, is of a semilunar shape and called the valve of Botal; it has a convex border, adherent, and turned downwards; and a concave border, free, and turned upwards. The angles resulting from the union of these borders are at birth attached to each side of the foramen about a quarter of an inch distant from each other. The valve makes its appearance in the fœtus at the third month of intra-uterine existence, and gradually increases in size, so as to more than cover the foramen at the period of birth. When the child breathes and the lungs become filled with blood, the fluid, entering the left auricle by the pulmonary veins, throws down the valve against the septum auriculorum, to which its free border usually becomes firmly united.

—Occasionally, however, the union of the parts is found so incomplete, even in old persons, as to allow a probe or even the handle of a scalpel to be passed obliquely through the opening: the obliquity of the orifice being such, as usually to enable it to act as a perfect valve. A communication of this sort, of greater or less magnitude between the auricles, exists

in adults, according to Biot, in the ratio of one to four. But judging from my own observations, this proportion of cases in which the opening exists is much too great. Sometimes the foramen is met with in adults so dilated as to be nearly an inch in diameter. I have met with two cases of this sort in the dissecting-room, both of which occurred in females between twenty and thirty years of age. The nutritive functions appeared to have been perfectly well performed in both these subjects, judging from the state of the body; the right auricle and ventricle were dilated and hypertrophied so as to present the same thickness of parietes as the corresponding parts of the left side. The tricuspid valves, and the semilunar valves of the pulmonary artery were thickened, and presented cartilaginous concretions on their edges, in which the work of ossification had just commenced. This thickening and ossification of the valves is almost wholly peculiar in the normal formation of the heart to the valves to the left side, and appears to be caused, as was first suggested by Cruveilhier, by the force with which the blood is dashed against the valves, in the forcible contractions of the ventricle.—

The Pulmonary Artery and the Aorta,

Have a communication in the fœtus, which is very analogous to the communication between the auricles of the heart.

From the pulmonary artery, where it divides into the two great branches, another large branch continues in the direction of the main trunk, until it joins the aorta; with which vessel it communicates at a small distance below the origin of the left subclavian artery. In the young subject that has never respired, it appears as if the pulmonary artery was continued into the aorta, and sent off in its course a branch on each side, much smaller than itself, to each lung. In subjects that have lived a few days, these branches to the lungs are much larger; and then the main pulmonary artery appears to have divided into three branches: one to each lung, and one to the aorta; but that which continues to the aorta is larger than either of the others.

In the course of time, however, this branch of the aorta is contracted, so that no fluid passes through it; and it has the appearance of a ligament, in which state it remains.

The course of the blood from the right ventricle, through the pulmonary artery to the aorta below its curve, is more direct than that from the left ventricle to the same spot through the aorta at its commencement. The column of blood in the aorta below its curve is evidently propelled by the force of both ventricles: and this circumstance, although it seems to proceed merely from the state of the fœtal lungs, is particularly calculated for the very extensive circulation which the fœtus carries on, by means of the umbilical arteries and vein in the placenta.

The Lungs of the Fœtus

Differ greatly from those of the adult. They appear solid, as if they were composed of the parenchymatous substance which constitutes the matter of glands, rather than the light spongy substance of the lungs of adults. They differ also in colour from the lungs of older subjects, being of a dull red.

They have greater specific gravity than water; but if air be once inspired, so much of it remains in them that they ever afterwards float in the former fluid.

The nature of the process of respiration, and its effects upon the animal economy, particularly upon the action of the heart, appear to be much better understood at this time than they were before the discovery of the composition of the atmosphere, by Dr. Priestley and Mr. Scheele. The publications upon this subject, which have appeared since that period, namely, 1774, are therefore much more interesting to the student of medicine than those which preceded them. Two of these publications ought to be particularly noticed by him; namely, an essay, by Dr. Edward Goodwyn, entitled, "The Connexion of Life with Respiration;"—and the "Physiological Researches of M. Bichat upon Life and Death." Part Second.*

The general doctrines respecting the oxygenation or decarbonization of the blood and the absolute necessity that it should take place to a certain degree in order to

* The student will derive much information respecting the publications on this subject, prior to 1804, from Dr. Bostock's Essay on Respiration.—Since the publication of that essay several interesting papers on respiration have appeared, namely, Two Memoirs by the late Abbe Spallanzani; "An Inquiry into the Changes induced on Atmospheric Air by the Germination of seeds," &c., by Ellis; two very important communications by Messrs. Allen and Pepys in the Transactions of the Royal Society of London for 1808 and 1809; and "Farther Inquiries into the Changes induced on Atmospheric Air," also by Ellis.

preserve life, are confirmed by a number of cases of malformation of the heart or the great vessels, in which the structure was such that a considerable portion of venous blood passed from the right side of the heart to the aorta, without going through the lungs. In these different cases, notwithstanding the structure was somewhat varied, the symptoms produced were very much alike; differing in the respective patients in degree only, and not in kind.

The symptoms indicating this structure, are blue colour of the face, (such as generally accompanies suffocation,) extending more or less over the whole body, and particularly apparent under the nails of the fingers and toes; anxiety about the region of the heart; palpitation; laborious respiration; sensations of great debility, &c.: all of which are greatly aggravated by muscular exertion. These effects have generally appeared to be proportioned to the quantity of venous blood admitted into the aortic system.*

When these appearances take place immediately after birth, it is probable that they depend entirely upon malformation of the heart or great vessels; but when they commence at a subsequent period, they are commonly the effect of a diseased alteration in the lungs. They sometimes occur near the termination of fatal cases of pneumonia or catarrh; but a different cause, which has not latterly been suspected, appears to have produced them in the following case, related by Dr. Marcet, in the first volume of the Edinburgh Medical and Physical Journal.

The blue colour occurred in a young woman, twenty-one years of age, in whom it had never been observed before. It came on during an affection of the breast, and was attended with great prostration of strength and difficulty of breathing, as well as cough, œdema of the hands and feet, and several other symptoms. About seven weeks after the commencement of these symptoms, she died; when it was ascertained by dissection, *that there was no unnatural communication whatever between the cavities of the heart, and that its valves were all in a perfect and natural state.* The lungs were free from tubercles, or any other appearance of disease. Their substance seemed *more compact* than usual, especially the left lung, although it did not sink in water; *but they adhered every where to the inner surface of the thorax, to the diaphragm and to the pleura covering the pericardium.* This case is the more remarkable, because numberless instances have occurred, in which very large portions of the external surface of the lungs have been found, upon dissection, to adhere to the internal surface of the thorax, without the occurrence of such symptoms during life.

It may be inferred, from a statement published by M. Dupuytren, in a volume of the Proceedings of the National Institute of France, that the oxygenation or decarbonation of the blood is much affected, in respiration, by an influence exercised by the nerves which are appropriated to the lungs. From his account it appears, that although the complete division of the eighth pair of nerves produces death after some time; yet in the horse, whose nerves are thus divided, life continues,

* Cases of this kind are related in several of the periodical publications on medical subjects. Two of them were described by Dr. William Hunter in the sixth volume of "Medical Observations and Inquiries by a society of Physicians in London;" one quoted by Dr. Goodwyn, is in the Observationes Anatomicæ of Sandifort; and another by Dr. J. S. Dorsey, has been published in the first number of the New England Journal of Medicine and Surgery.

and respiration goes on, from half an hour to ten hours; but his arterial blood is in a state of great disoxygenation or carbonation during this time. This fact is more remarkable because venous blood, contained in a bladder exposed to the open air will become oxygenated or decarbonated.

It is also asserted in another Memoir, read to the National Institute by Dr. J. M. Provençal; that animals, in whom the eighth pair of nerves has been divided, do not consume so much oxygen, or produce so much carbonic acid, by a considerable degree, as they did before the division of these nerves; and that their temperature is considerably reduced.*

The effect, that venous blood occasions death, when it is admitted into the left ventricle of the heart, and the aorta, is truly important. Dr. Goodwin explained it by suggesting that this blood was not sufficiently stimulating to produce the necessary excitement of the heart; but on this occasion one of his friends proposed to him the following question: Why does venous blood affect the left side of the heart in this injurious manner, when it appears to exert no noxious effects whatever on the right side of that organ? His reply may be seen in a note at the 82d page of his Essay, in the first edition. Bichat has offered a solution which completely resolves this difficulty, viz. "The effect of venous blood upon the heart is produced by the presence of this blood in the proper, or coronary arteries of that organ, and not in its great cavities." For the animation of the heart, like that of the other parts of the body, depends upon the state of the blood in the arteries which penetrate its texture.† And while the heart acts, the blood of the coronary arteries will be the same with that of the left ventricle. See Bichat's Researches, P. II. art. 6, § 2.

The French anatomists at one time entertained some peculiar opinions respecting the course of the blood in the fœtus, which have a particular relation to the subject last mentioned. Winslow, who paid great attention to the valve of Eustachius in the right auricle of the heart, was of opinion, that this valve was calculated for some important purpose in the fœtal economy.‡ Although his hypothesis respecting its particular use has not been retained by his countrymen, many of them have adopted his general sentiment; and among others Sabatier. That learned anatomist believed that this valve, in the fœtal state, serves *to direct the blood of the inferior cava, after its arrival in the right auricle through the foramen ovale into the left auricle; while the blood of the upper cava passes directly into the right ventricle.* His opinion seems to be supported to a certain degree—

1. By the direction in which the two columns of blood enter the auricles from the two venæ cavæ.

2. By the position of the Eustachian valve.

3. By the foraman ovale, when its valve is complete; as the passage through it from the right to the left, is at that time oblique, and from below upwards.

The theory of Sabatier appears to be this:—the umbilical vein brings from the

* These Memoirs were republished in the Eclectic Repertory of Philadelphia for April and October, 1811.

† It is probable that the contents of the great cavities of the heart have no more effect upon its animation than the contents of the stomach and bowels have upon the animation of those organs.

‡ See Memoirs of the Academy of Sciences for 1717 and 1725.

placenta blood which has a quality essential to the animation of the fœtus. If there were no particular provision to the contrary, a large portion of this blood, after passing from the umbilical vein by the inferior cava into the right auricle of the heart, would proceed by the right ventricle through the pulmonary artery and arterial canal, into the aorta, below the origins of the carotid and subclavian arteries; and consequently none of it would pass to the head and upper extremities, but a considerable part would return again by the umbilical arteries to the placenta, without circulating through the body: while, on the other hand, the blood which passed by the carotid and subclavian arteries to the head and upper extremities returning from them to the heart by the superior cava, might pass from the right auricle to the left auricle and ventricle and the aorta, and so to the head and upper extremities again, without passing through the placenta. But by means of this valve, the blood of the lower cava, and of course of the umbilical vein, is directed to the left auricle and ventricle and the aorta, by which a considerable portion of it will necessarily pass to the head and upper extremities; while the blood which returns from these parts by the superior cava, must consequently pass from the right auricle into the right ventricle and pulmonary artery; from whence a large portion of it will proceed through the arterial canal into the aorta beyond the carotids and subclavians, and of this portion a considerable part will go to the placenta by the umbilical arteries. Sabatier compares the course of the blood in the fœtus to the course of a fluid in a tube which has the form of the numeral character 8.* If this doctrine be true, the progress of the blood in the fœtus and placenta is very analagous to that of the double circulation of the adult; the character 8 answering equally well in the description of either subject.

According to Sabatier, the blood of the placenta takes this peculiar course through the heart, in order that some of it may be carried to the head and upper extremities. But an additional reason may be suggested, which appears to be of great importance; namely, the supplying of the coronary or *proper* vessels of the heart, with some of the same blood.

The heart of the adult, as has been before stated, cannot act without its proper or coronary arteries are supplied with arterial blood. The heart of the fœtus performs a more extensive circulation than that of the adult, and, therefore, is probably in greater need of such blood. But *unless the blood of the placenta pass through the foramen ovale into the left auricle and ventricle, and so to the aorta, it cannot enter the coronary arteries which originate at the commencement of the aorta;* for the blood which flows from the right side of the heart through the arterial canal, passes into the aorta at so great a distance from the orifices of the coronary arteries, that it certainly cannot enter them.

The whole of this doctrine seems to be supported by a fact very familiar to accoucheurs, viz. the occurrence of death in the fœtus whenever the circulation through the umbilical cord is suspended during fifteen or twenty minutes; for as the placenta imparts to the fœtal blood a quality essential to life, some arrangement seems necessary to provide for the equal distribution of the blood which comes from this organ, and especially for carrying the requisite proportion of it to the substance of the heart.

Life has existed for some time with a structure very different indeed from that which is natural. In the series of elegant engravings relating to morbid anatomy,

* See Sabatier's Paper on this subject, in the Memoirs of the Academy of Sciences, for 1774.

published by Dr. Baillie, is the representation of a heart, in which the venæ cavæ opened into the right auricle, and the pulmonary veins into the left auricle, in the usual manner; but the aorta arose entirely from the right ventricle, and the pulmonary artery as completely from the left. The canalis arteriosus, however, passed from the pulmonary artery to the aorta, and the foramen ovale existed. In this case, it is evident, that the pulmonary artery must have carried back to the lungs the arterial blood which came from them by the pulmonary veins, with a small quantity of venous blood that passed into the left auricle through the foramen ovale; and that the aorta must have returned to the body the venous blood, which just before had been brought from it by the venæ cavæ, with a small addition of arterial blood that passed through the ductus arteriosus. Yet with this structure the child lived two months after its birth.

A case, which had a strong resemblance to the foregoing, occurred in Philadelphia, and was examined by the author of this work. The venæ cavæ terminated regularly in the right auricle, and the pulmonary veins in the same regular manner in the left; but the pulmonary artery arose from the left ventricle, and the aorta from the right. *There was no communication between these vessels by a canalis arteriosus;* but a large opening existed in the septum between the auricles.

It is very evident, that, in this case also the pulmonary artery must have returned to the lungs the arterial blood as it came from them, and the aorta must have carried back to the general system the venous blood brought to the heart by the cavæ; excepting only those portions of the arterial and venous blood which must have flowed reciprocally from one auricle into the other, and thus changed their respective situations.

The subject was about two years and a half old. The heart was nearly double the natural size, and the foramen, or opening in the septum between the auricles, was eight or nine lines in diameter. The pulmonary artery was larger in proportion than the aorta or the heart.

With this organization, the child lived to the age above specified. His countenance was *generally* rather livid; and this colour was always much increased by the least irregularity of respiration. His nails were always livid. He sometimes appeared placid, but more frequently in distress. He never walked, and seldom, if ever, stood on his feet. When sitting on the floor, he would sometimes push himself about the room; but this muscular exertion always greatly affected his respiration. He attained the size common to children of his age, and had generally a great appetite. For some weeks before death his legs and feet were swelled.

It is probable that the protraction of life depended upon the mixture of the blood in the two auricles; and that they really were to be considered as one cavity, in this case.

There seems reason to believe, that in adults of the common structure, there is no passage of blood from one auricle to the other, when the foramen ovale has remained open; because in several persons in whom it was found by dissection to have remained open, there were no appearances during life, that indicated the presence of disoxygenated blood in the aortic system. It is probable, that the small size of the foramen ovale, the valvular structure which generally exists there, and the complete occupation of the left auricle by the blood flowing from the pulmonary veins, prevent the passage of blood from the right auricle to the left, in such persons; whereas in the case in question, the opening between the auricles was very large indeed, and there was no appearance of a valve about it.

Although it be admitted, that in adults with the foramen ovale pervious, there is no transmission of blood from the right to the left auricle; there is every reason to believe, that this transmission goes on steadily in the fœtus. To the arguments derived from the structure and the nature of the case, it may be added, that the pulmonary veins, in the fœtal state, carry to the left auricle a quantity of blood, not sufficient to fill it; while the venæ cavæ carry to the right auricle, not only the whole blood of the body, but of the umbilical cord and placenta: some of which must flow into the unfilled left auricle, when the right auricle becomes fully distended.

The question, how far the functions of the heart and lungs are dependent upon the brain, is very important, and has often been agitated with great zeal. In favor of the opinion that the motions of the heart are independent of the brain, may be stated the numerous cases in which the brain has been deficient in children, who have notwithstanding lived the full period of utero-gestation, and even a short time after birth, and have arrived at their full size, with every appearance of perfect vigour and action in the heart. In support of the doctrine, that the action of the heart is immediately dependent upon the brain, it may be observed, that no organ of the body appears to be so much influenced by passions and other mental affections as the heart. These contradictory facts have occasioned this question to be considered as undecided, if not incapable of solution; although Cruikshank and Bichat* have stated circumstances very favourable to the opinion that the motions of the heart are independent of the brain.

This question seems now to be settled by the experiments of Dr. Legallois, a physician of Paris, which prove, that in animals who have suffered *decapitation*, the action of the heart does not cease as an immediate consequence of the removal of the head; but its cessation is an *indirect effect*, induced by suspension of respiration. That respiration is immediately affected by decapitation, and depends upon the influence of the brain transmitted through the eighth pair of nerves. That the action of the heart will continue a long time after decapitation, if inflation of the lungs, or artificial respiration, be performed; but, on the contrary, if the *spinal marrow* be destroyed, the action of the heart ceases irrecoverably.

The inference from these experiments seems very conclusive, that the *Spinal Marrow*, and not the brain, is the source of the motions of the heart.

It appears also by some of the experiments, that the power of motion in the *trunk* of the body, is derived from the spinal marrow; and that, when this organ is partially destroyed, the parts which receive nerves from the destroyed portion soon cease to live. By particular management of the spinal marrow, one part of the body can be preserved alive for some time after the other parts are dead.

These experiments of Dr. Legallois, commenced in 1806, or 1807, were com-

* See Cruikshank's Experiments on the Nerves and Spinal marrow of living Animals; London Philosophical Transactions for 1795. The eighth experiment has a particular relation to this subject. Bichat's researches, part 2, article 9.

The Abbe Fontana has considered this subject in his Treatise on the Venom of the Viper, vol. ii. page 194, English translation; and also in some of his other works.

municated to the imperial Institute of France, in 1811. The committee of that body, to whom they were referred, namely, Messrs. Humboldt, Halle, and Percy, reported that the experiments had been repeated before them, at three different meetings of several hours each; and that, to allow themselves sufficient time for reflection, they suffered an interval of a week to take place between the meetings. The committee believe these experiments to have proved,

1st. That the principle upon which all the movements of inspiration depend, has its seat about that part of the medulla oblongata from which the nerves of the eighth pair arise.

2nd. That the principle which animates each part of the trunk of the body, is seated in that portion of the spinal marrow from which the nerves of the part arise.

3d. That the source of the life and strength of the heart is also in the spinal marrow; not in any distinct portion, but in the whole of it.

4th. That the great sympathetic nerve is to be considered as originating in the spinal marrow, and that the particular character of this nerve is to place each of the parts to which it is distributed under the immediate influence of the whole nervous power.

The interesting memoir of Dr. Legallois is confirmed to a certain degree by a communication of B. C. Brodie to the Royal Society of London in 1810, in which are detailed many very interesting experiments, which induced the author to conclude,

That the influence of the brain is not directly necessary to the action of the heart; and

That when the brain is injured or removed, the action of the heart ceases only because respiration is under its influence; and if, under these circumstances, respiration is artificially produced, the circulation will still continue.

These various experiments apply particularly to the cases in which the brain is deficient. The effects of mental agitation on the heart are likewise reconcilable to the theory which arises out of them. But they throw no light on the question why the motions of the heart are so perfectly free from the influence of the will: and although they seem to prove incontestably that the motion of the heart is independent of the brain, it ought to be remembered that in certain diseased states of the brain, where that organ appears to be compressed, the action of the heart is often very irregular, and its contractions less frequent than usual.

—For a later and more accurate account of the functions of respiration, the reader is referred to Dunglison's "Human Physiology, 4th Ed., Phila. 1841.—

END OF VOL. I.